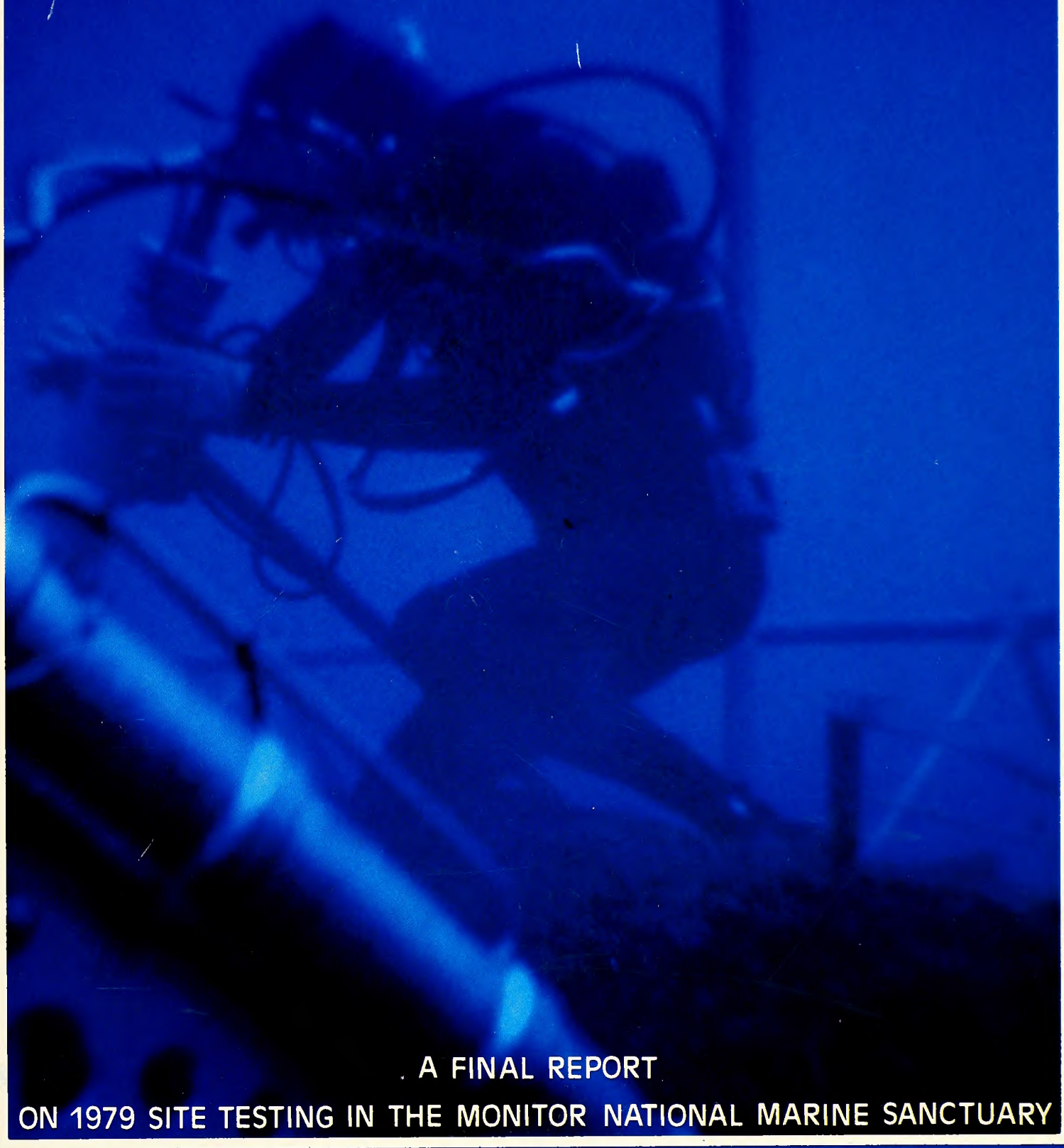
INVESTIGATING THE REMAINS OF THE

U.S.S. MONITOR



A FINAL REPORT
ON 1979 SITE TESTING IN THE MONITOR NATIONAL MARINE SANCTUARY

BY GORDON P. WATTS, JR.
NORTH CAROLINA DEPARTMENT OF CULTURAL RESOURCES

INVESTIGATING THE REMAINS OF THE U.S.S. *MONITOR:*

A FINAL REPORT ON 1979 SITE TESTING IN THE *MONITOR* NATIONAL MARINE SANCTUARY

by

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This volume is dedicated to Edwin A. Link, 1904-1981, whose innovative genius, commitment to underwater exploration and research, and personal interest made this investigation of the remains of the U.S.S. Monitor possible.

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ACKNOWLEDGMENTS

A project as complex as the 1979 investigation in the *Monitor* National Marine Sanctuary could not have been successful without the interest, support, and cooperation of a great number of agencies, institutions, and individuals. Primary support for the project was provided by Harbor Branch Foundation, Inc., of Fort Pierce, Florida, the National Oceanic and Atmospheric Administration, and the North Carolina Department of Cultural Resources. Within the foundation and supporting agencies there are numerous individuals who deserve particular acknowledgment.

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Gratitude and appreciation must also be extended to the crew of the *Johnson-Sea-Link* comprised of Tim Askew, chief pilot; Richard Roesch, Bill Bond, and Richard Berg, submersible technicians; Mike Mitchell, electronics technician; and Dom Liberatore, medical technician. It was their training, technical assistance, and participation in on-site activities that ensured that the operation would be both safe and successful. Similar thanks are also in order for the crew of the Research Vessel *Johnson*. As was the case with the crew of the *Johnson-Sea-Link*, on-site operations would have been impossible without the support of Captain Joe Morgan; George Chapman, mate; Harry Spaulding, chief engineer; Edmund Warren, engineer/seaman; Rodney Coffman, seaman; and Steve Cartwright, steward. Working with the crews of both vessels was a pleasure.

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Within the North Carolina Department of Cultural Resources, special thanks must be expressed to Sara Hodgkins, secretary of the department; Larry Tise, former director of the North Carolina Division of Archives and History; and Brent Glass, former head of the Archaeology and Historic Preservation Section, for their support of the project. In addition, our successful participation would not have been possible without the special attention of Administrative Secretary Sondra Ward and both Sarah Freeman and Bobby Holleman of the Budget Office.

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INTRODUCTION

The location and identification of the remains of the U.S.S. *Monitor* focused renewed attention on the celebrated warship and stimulated extensive interest in salvaging the wreck. To ensure that the vessel would be preserved for systematic investigation and responsible development, preservation-conscious government agencies, institutions, and organizations cooperated to nominate the ship to the National Register of Historic Places and designate its present location the nation's first marine sanctuary. Since that designation the National Oceanic and Atmospheric Administration, charged with management responsibility for the *Monitor* National Marine Sanctuary, and the North Carolina Department of Cultural Resources have worked closely to develop a sound management program. On March 5, 1979, these activities culminated in the adoption of a master planning document designed to identify research and development goals and objectives. With the assistance and support of Harbor Branch Foundation, a project to address the first on-site objectives identified in the master planning document was carried out during August, 1979. A sophisticated submersible delivery system permitted archaeologists to install the nucleus of an on-site datum system, conduct the first test excavation inside the vessel, and document firsthand the condition of previously uninvestigated areas of the wreck. Data generated by the project significantly broadened the knowledge upon which management decisions must be made and provided valuable insight into the archaeological and engineering problems presented by this and other deepwater archaeological sites.

HISTORICAL BACKGROUND

On April 19, 1861, the recently elected President Abraham Lincoln proclaimed a blockade of the seaports in those southern states attempting to withdraw from the Union. Unfortunately, the United States Navy was almost totally unprepared to carry out Lincoln's "grand strategy." Since the War of 1812, congressional indifference had allowed naval strength to decline steadily. Only a few of those vessels that could be considered fit for service were steamers, and none of these armored. Hesitant to initiate a large-scale program to construct a fleet of modern armored war steamers until prototype designs could be tested, the United States instead made a concerted effort to purchase or charter sufficient vessels to solve the immediate problem.

At the outbreak of hostilities the South literally had no navy. Aside from a relatively few ships that were captured in southern ports when the rebellion began, only a few privately owned vessels were found to be suitable for conversion to warships of any consequence. Without a navy and lacking the necessary industrial potential to keep pace with the North in constructing one, the South proved more receptive to the idea of constructing armored war steamers. Less than three months after the first shot had been fired into Fort Sumter on April 12, 1861, the Confederate States Navy began putting the first of these proposals into effect.

When the state of Virginia seceded from the Union, the Gosport Navy Yard near Norfolk, Virginia *(Figure 1)*, fell into Confederate hands. Along with the extensive ship houses, lofts, mills, foundries, ships, and stores, the yard contained a sizable dry dock *(Still, 1971)*.

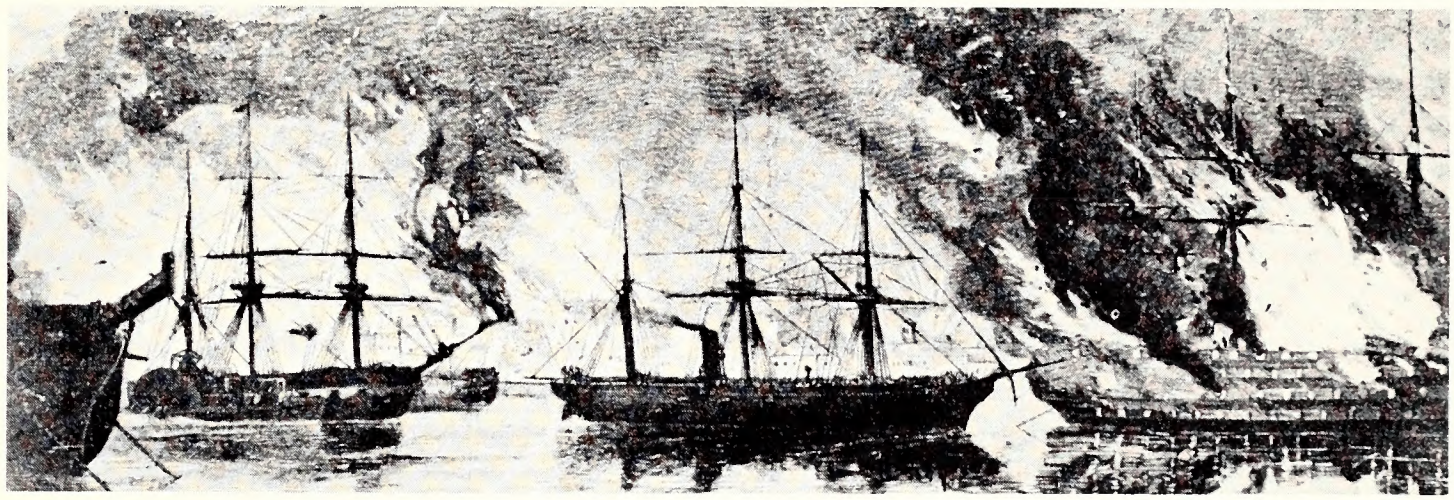


Figure 1. In spite of extensive damage resulting from Union efforts to destroy vessels in the Gosport Navy Yard, the hull and machinery of the U.S.S. ***Merrimack*** *were found to be suitable for conversion into an ironclad.*

Although Union officers made an attempt to destroy the facilities and ten U.S. Navy warships at the yard for repairs, the effort proved to be only partially successful. When Virginia state militia occupied the abandoned facilities on April 21, 1861, damage to the equipment was found to be slight. While nine of the ten vessels were found to be useless, the burned and scuttled steam frigate U.S.S. *Merrimack* was determined to be sound below her berth deck *(Melton, 1968)*. By the middle of July, 1861, the *Merrimack* had been raised and moved into the yard's dry dock where carpenters and engineers were working to convert the hull into an ironclad ram designed by Lieutenant John M. Brooke of the Confederate States Navy *(Figure 2)*.

According to Lieutenant Brooke's plans, the remains of the *Merrimack*'s superstructure were cut away and replaced by an inclined casemate armored with a 2-inch thickness of iron plate. In addition to carrying an impressive battery of six 9-inch Dahlgren smoothbore cannon, two 7-inch, and two 6.4-inch Brooke rifled guns, the vessel's bow was fitted with a submerged ram. Commissioned on February 17, 1862, as the C.S.S. *Virginia*, the ironclad represented a very potent threat to the wooden fleet of the United States Navy blockading Hampton Roads *(Still, 1971)*.

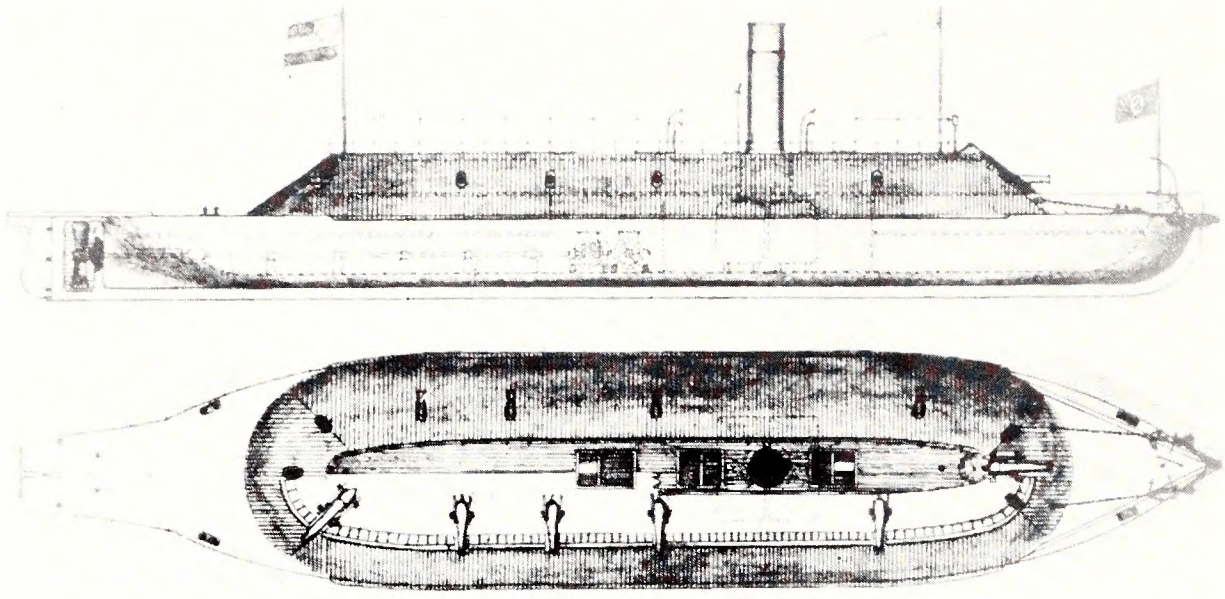


Figure 2. General plans for the conversion of the U.S.S. Merrimack developed by Lieutenant John M. Brooke, CSN.

Shortly after the conversion of the *Merrimack* began, word of its construction reached Union Secretary of the Navy Gideon Welles. After receiving news, the Navy Department closely followed the progress of the Confederate ironclad. In spite of the efforts of southern newspapers to mislead the enemy, Welles was able to piece together a surprisingly accurate picture of the vessel. While the construction of Union ironclads was not initiated solely as an answer to the threat posed by the *Virginia*, the news of her construction most assuredly contributed to the atmosphere of urgency under which the program was adopted.

On July 4, 1861, Secretary Welles had urgently requested congressional authorization for the construction of several ironclad warships. His request was approved on August 3, when "An Act to Provide for the Construction of One or More Armored Ships and Floating Batteries and for Other Purposes" was passed *(Senate Ex. Doc. No. 86, 1868)*. This empowered Welles to appoint an "Ironclad Board" composed of three naval officers to evaluate plans for ironclad warships and made available an appropriation of $1.5 million to finance construction of those designs that met their approval. Four days later, the Navy Department announced that the review board was accepting proposals.

When the board's conclusions were reported in mid-September, three designs had been approved *(Senate Ex. Doc. No. 86, 1868)*. The first of these was the *Galena (Figure 3)*, submitted by C. B. Bushnell and Company of New Haven, Connecticut. The *New Ironsides (Figure 4)*, designed by Merrick and Sons of Philadelphia, became the second. Both of these vessels were conventional designs similar to the ironclads *Warrior* and *La Gloire* already in use in Britain and France. The third design accepted by the board was that of the steam turreted battery presented by Swedish-American engineer John Ericsson and later named the U.S.S. *Monitor (Figure 5), (Senate Ex. Doc. No. 86, 1868)*.

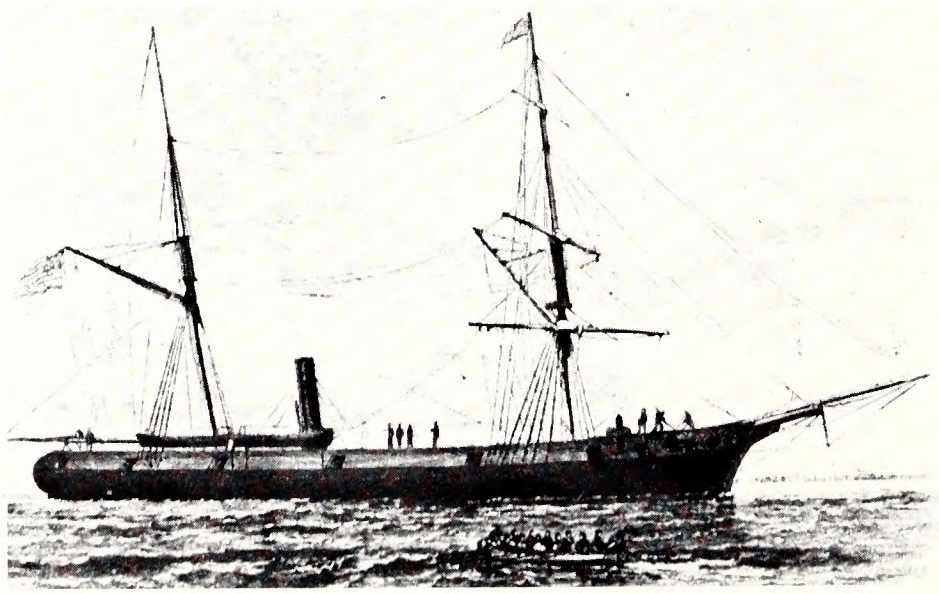


Figure 3. U.S.S. Galena constructed by C. B. Bushnell and Company of New Haven, Connecticut.

While the Ironclad Board readily accepted the conservative proposals for the *Galena* and *New Ironsides*, they balked at Ericsson's radical design. It was only after Ericsson's plans had been presented to President Lincoln and an assembly of ranking naval officers that the board was willing to issue its conditional acceptance. It was their recommendation that the *Monitor* be built on an experimental basis and that Ericsson and his associates would forfeit the contract if the vessel failed to meet or surpass any of his claims.

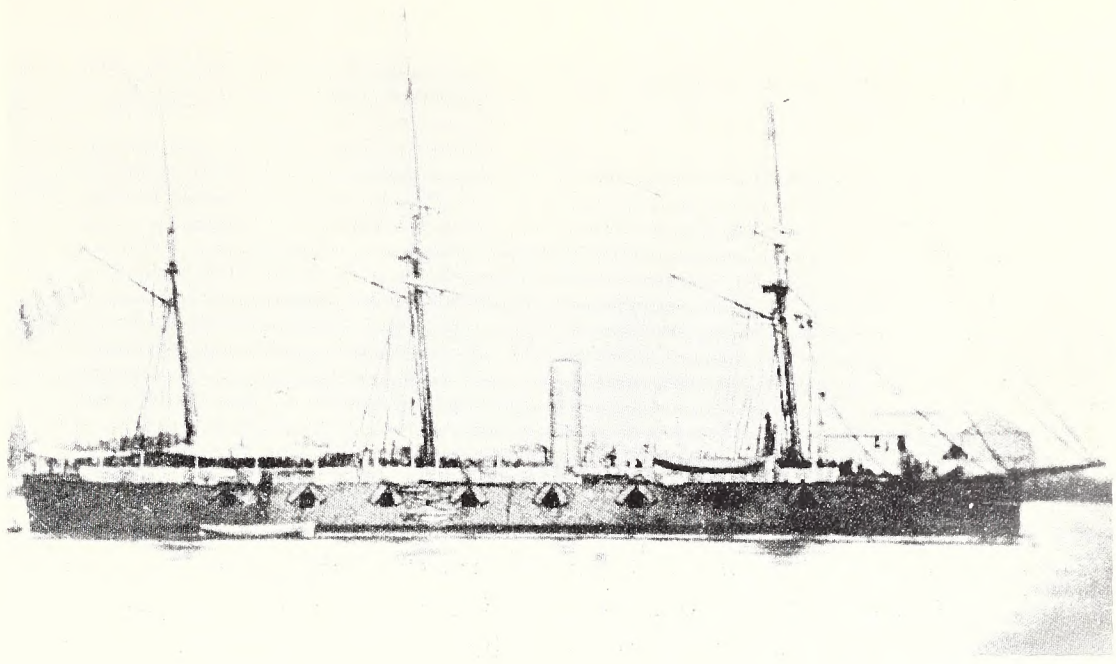


Figure 4. The U.S.S. New Ironsides, designed by Merrick and Sons of Philadelphia, Pennsylvania.

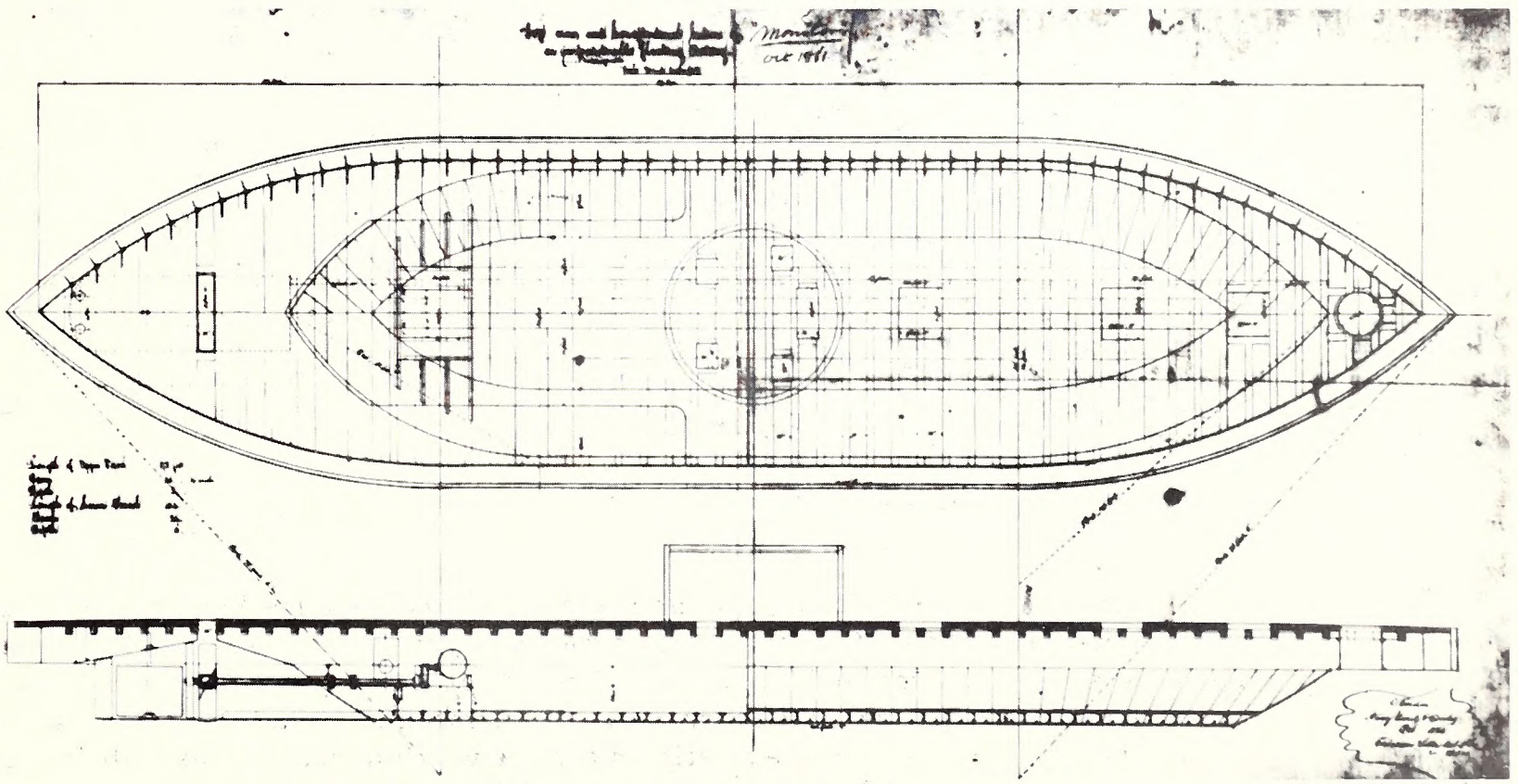


Figure 5. One of a series of original plans illustrating details of the U.S.S. Monitor developed by Swedish-American engineer John Ericsson.

In spite of this rather precarious arrangement, Ericsson, backed by a recently formed association with three influential and well-to-do industrialists, began work on the vessel immediately. According to their agreement with Secretary Welles, the completed ship was to be delivered to the United States Navy within 100 days. To ensure that construction would proceed with the utmost dispatch, Ericsson decided to rely on separate subcontractors to handle the construction of the hull, turret, engines, and machinery. Additional suppliers were engaged to provide the tremendous amounts of plates, angle iron, spikes, pins, belts, fittings, and other materials that were required. This technique allowed almost every aspect of the construction to be carried out simultaneously.

No comprehensive blueprints of the vessel existed at the outset of construction, but Ericsson managed to keep the work moving at a furious pace by keeping an endless stream of rough working drawings flowing from his office. Some of these were converted into finished plans by his assistant Charles W. McCord, but frequently they were supplied to the subcontractors in their rough form. Following these specifications, the firms of Cornelius DeLameter and Company and Novelty Iron Works, both of New York City, carried out the construction of the machinery (i.e., engine, boilers, propeller) and turret respectively. Upon completion these were delivered to the shipyard of Thomas F. Rowland's Continental Iron Works in Greenpoint, Brooklyn, Long Island, where the hull was built. Both the navy's delinquency in making payments and shortages of material created delays in construction, but by late January, 1862, the vessel was ready for launching.

Amid a veritable barrage of skepticism, "Ericsson's Folly" slipped down the ways at the Continental Shipyard on January 30, 1862 *(Figure 6)*. Although construction had run over the specified 100 days, recent news of the *Virginia*'s progress checked any thoughts of canceling Ericsson's contract. A telegram from the assistant secretary of the navy reflects the prevailing attitude: "Hurry her to sea as the *Merrimack* is nearly ready at Norfolk" *(Fox, January 30, 1862)*. By February 19 the *Monitor* had been delivered to the Brooklyn Navy Yard to be armed and provisioned.

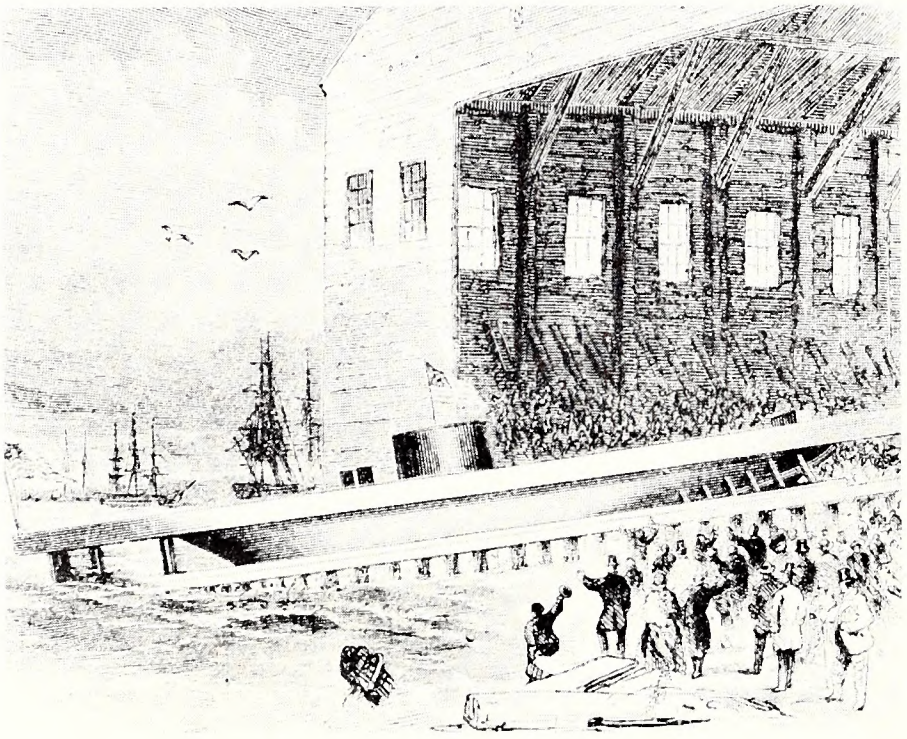


Figure 6. Although inaccurate in architectural detail, this artist's rendering of the launch of the "Ericsson Battery" captured public interest along with calculations that the vessel would "dive to the bottom, and obstinately refuse to float."

Following the mounting of the two 11-inch guns removed from the U.S.S. *Dacotah*, the boilers were fired in preparation for her first trial run. Complications developed immediately when defective cutoff valves failed to admit sufficient steam to the engines. As the design had been previously tested, Ericsson was confident that the problem could be remedied and set to work on it immediately. On the second trial the valves functioned normally, but difficulties in the steering made the vessel unmanageable. Satisfactory adjustments were made without returning the vessel to dry dock and the ship was quickly commissioned on February 25, 1862 *(MacBride, 1962)*.

On March 6, 1862, Lieutenant John L. Worden, newly appointed commanding officer of the vessel, reported that the ship was under tow by the steam tug *Seth Low* and was proceeding to Hampton Roads, Virginia *(Worden, March 6, 1862)*. Fortunately for the Union a telegram from the secretary of the navy ordering the *Monitor* to Washington to protect the capital arrived at the yard after the vessel's departure *(Welles, March 6, 1862)*.

The voyage to Hampton Roads very nearly proved a disaster for both the vessel and her crew. The first day of the voyage passed without incident, but the morning of March 7 brought a fresh wind and a rising sea. Throughout the day, conditions deteriorated and the ironclad began to ship water faster than her pumps could remove it. Water poured through the blower ducts and drenched the blower belts, rendering the ventilating system virtually useless. Without draft from the blowers, the boiler fires slowly died and smoke and noxious gasses choked the engine room personnel. By nightfall conditions were critical. Only a fortunate improvement in the weather permitted the convoy to reach Cape Charles, Virginia, late in the afternoon on March 8.

As the *Monitor* and her escorts were rounding Cape Henry, the *Virginia* was briskly engaged in the destruction of the Federal fleet at Hampton Roads *(Figure 7)*. Under the command of Flag Officer Franklin Buchanan, the Confederate ironclad steamed out of the Elizabeth River on March 8 and succeeded in destroying the wooden frigates U.S.S. *Cumberland* and U.S.S. *Congress* and damaging the stranded frigate U.S.S. *Minnesota* before returning to a protected anchorage near Norfolk. The *Monitor* arrived just in time for her crew to witness the explosion of the burning *Congress* at midnight. When the *Virginia* returned to complete the destruction of the *Minnesota* the following morning, the *Monitor* was cleared for battle *(Figure 8)*.

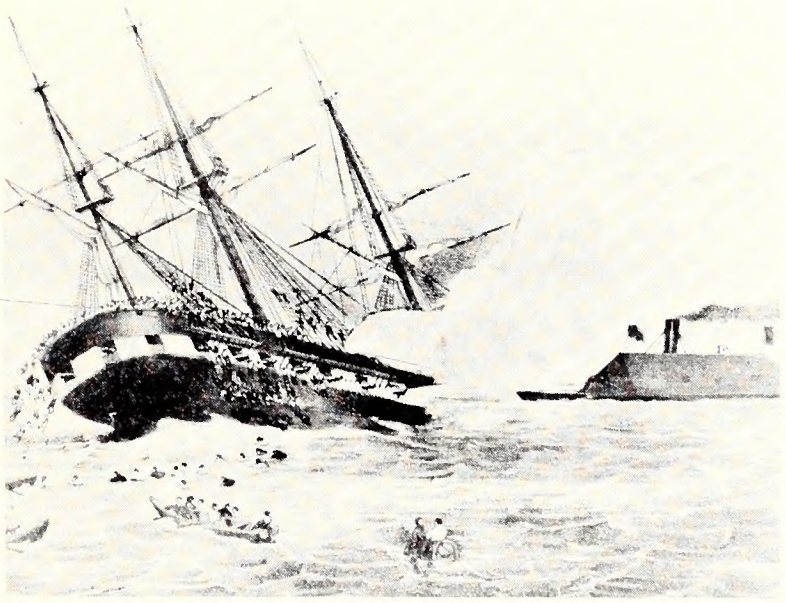


Figure 7. Although informed well in advance of the C.S.S. Virginia's first appearance in Hampton Roads, the Confederate ironclad's March 8, 1862, attack caught the Union fleet ill-prepared, with devastating results.

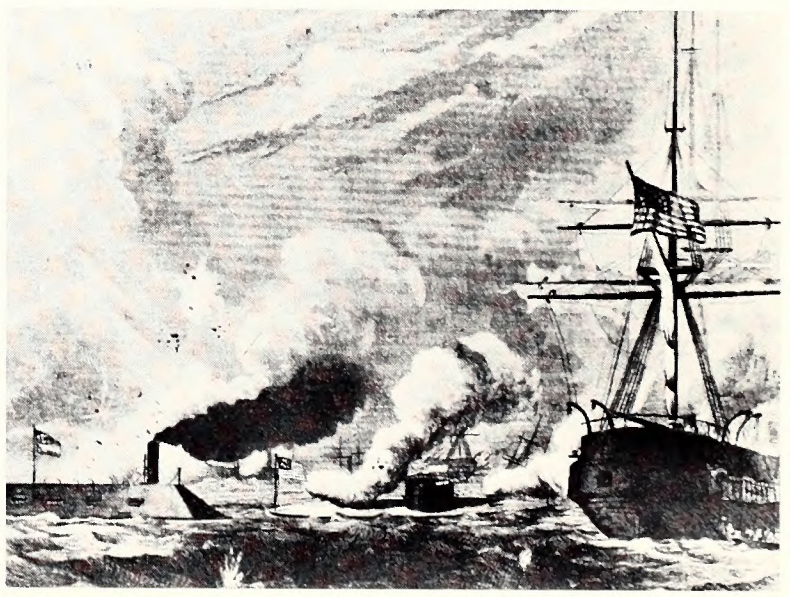


Figure 8. Returning on March 9, 1862, to destroy the stranded U.S.S. Minnesota, the crew of the C.S.S. Virginia was surprised to find the "Cheesebox-on-a-Raft" a worthy advisary.

At 6:00 A.M. the *Virginia*, in concert with the steamers C.S.S. *Patrick Henry*, C.S.S. *Jamestown*, and C.S.S. *Teaser*, steamed directly for the stranded frigate. The *Monitor*, having been ordered to protect the *Minnesota*, closed with the *Virginia*. For the next four hours the two vessels engaged each other continuously. In spite of extremely close ranges, frequently point blank, neither vessel was seriously damaged. While the *Monitor* won a tactical victory by protecting the stranded *Minnesota*, the *Virginia* achieved a strategic victory by establishing undisputed control of Hampton Roads and the James River. This position served to protect both Richmond and Norfolk and, at the same time, threatened Union campaigns planned for the Yorktown Peninsula during the spring of the year. Until the loss of Norfolk forced the crew of the *Virginia* to destroy the ironclad on May 11, 1862, a stalemate existed. Neither commander was willing to risk the consequences of losing his vessel. The loss of the *Monitor* would open the York River and General George McClellan's rear to the *Virginia*, while the loss of the latter would seriously expose Norfolk, the Gosport Navy Yard, and open the James River and Richmond to Union vessels.

Throughout the spring, summer, and fall of 1862, the *Monitor* remained in the area, unable to force the passage of the James River or to abandon Norfolk and Hampton Roads because of the threat presented by the construction of another ironclad, C.S.S. *Richmond*, further up the James River at Richmond, Virginia *(Figure 9)*. It was not until October that the vessel could be spared to undergo repairs at the Washington Navy Yard. From October 13 to 26 workmen at the yard labored to improve the ventilation system, refurbish the crew's quarters, overhaul engines and machinery, and clean and paint the hull. Additional work on the steam pipes kept the vessel in Washington until November, when she returned to Hampton Roads, Virginia. There, until late December, she waited in vain for the appearance of the *Richmond*.

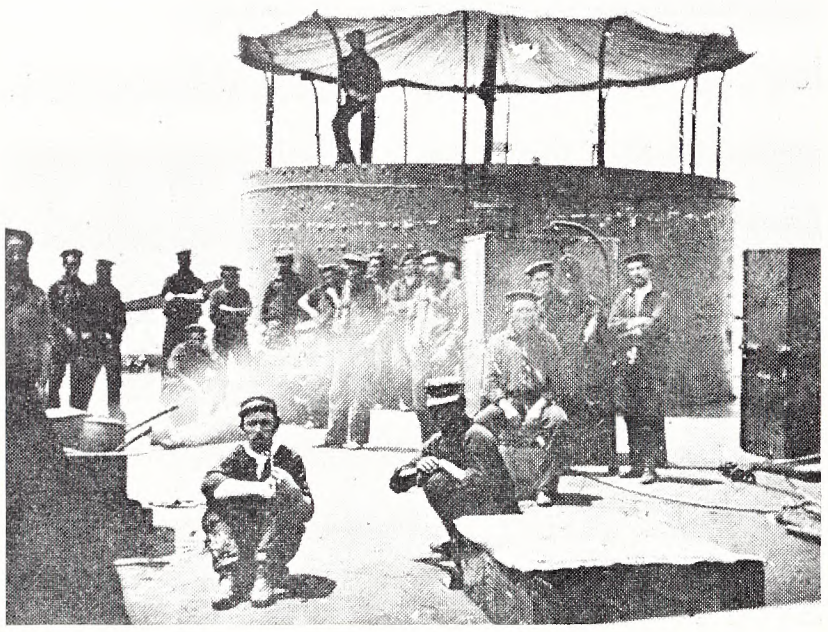


Figure 9. At anchor in Hampton Roads, the **Monitor***'s crew anticipates one of several meals cooked on deck while galley repairs corrected fire damage resulting from an improperly exhausted stove.*

On December 19, 1862, the U.S.S. *Rhode Island (Figure 10)*, under Commander S.P. Trenchard, completed the final preparations for towing the *Monitor* to Beaufort, North Carolina. Beaufort was to be the first stop in a voyage that was to take both the *Monitor* and the recently commissioned monitor U.S.S. *Passaic* to Charleston, South Carolina. There the ironclads were to assist in a proposed attack on the massive Confederate defenses that protected the harbor. According to orders from S.P. Lee, commander, North Atlantic Blockading Squadron, dated December 24, 1862, Trenchard was to take advantage of the "first favorable weather for making the passage" *(Lee, December 24, 1862)*.

Five days later Commander Trenchard ordered the *Rhode Island*'s hawser secured aboard the *Monitor* and steamed out of Hampton Roads. South of Cape Hatteras initially favorable weather deteriorated to squalls and heavy seas. Plunging through the seas the *Monitor* rapidly took on water around the turret, through the anchor well, and down the blower pipes. In spite of all efforts to remedy the situation, Commander Bankhead was forced to transmit a prearranged distress signal and ordered preparations for abandoning the sinking ship. At approximately 1:30 A.M. on December 31, 1862, the *Monitor* disappeared "about 25 miles south of Cape Hatteras. . . ." *(Figure 11) (Bankhead, January 27, 1863)*.

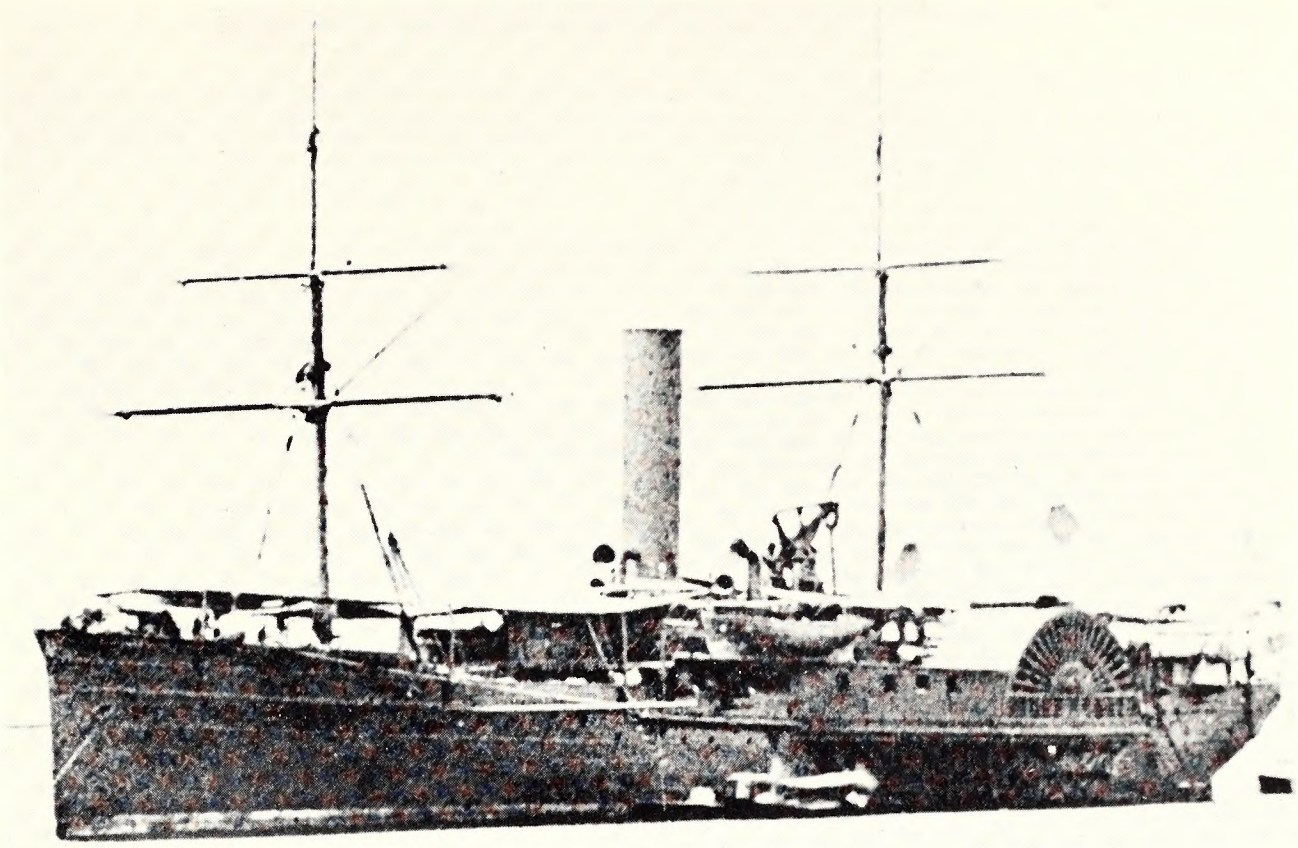


Figure 10. On December 29, 1862, the U.S.S. ***Rhode Island*** *under the command of Commander S. P. Trenchard took the* ***Monitor*** *in tow for the voyage to Beaufort, North Carolina.*

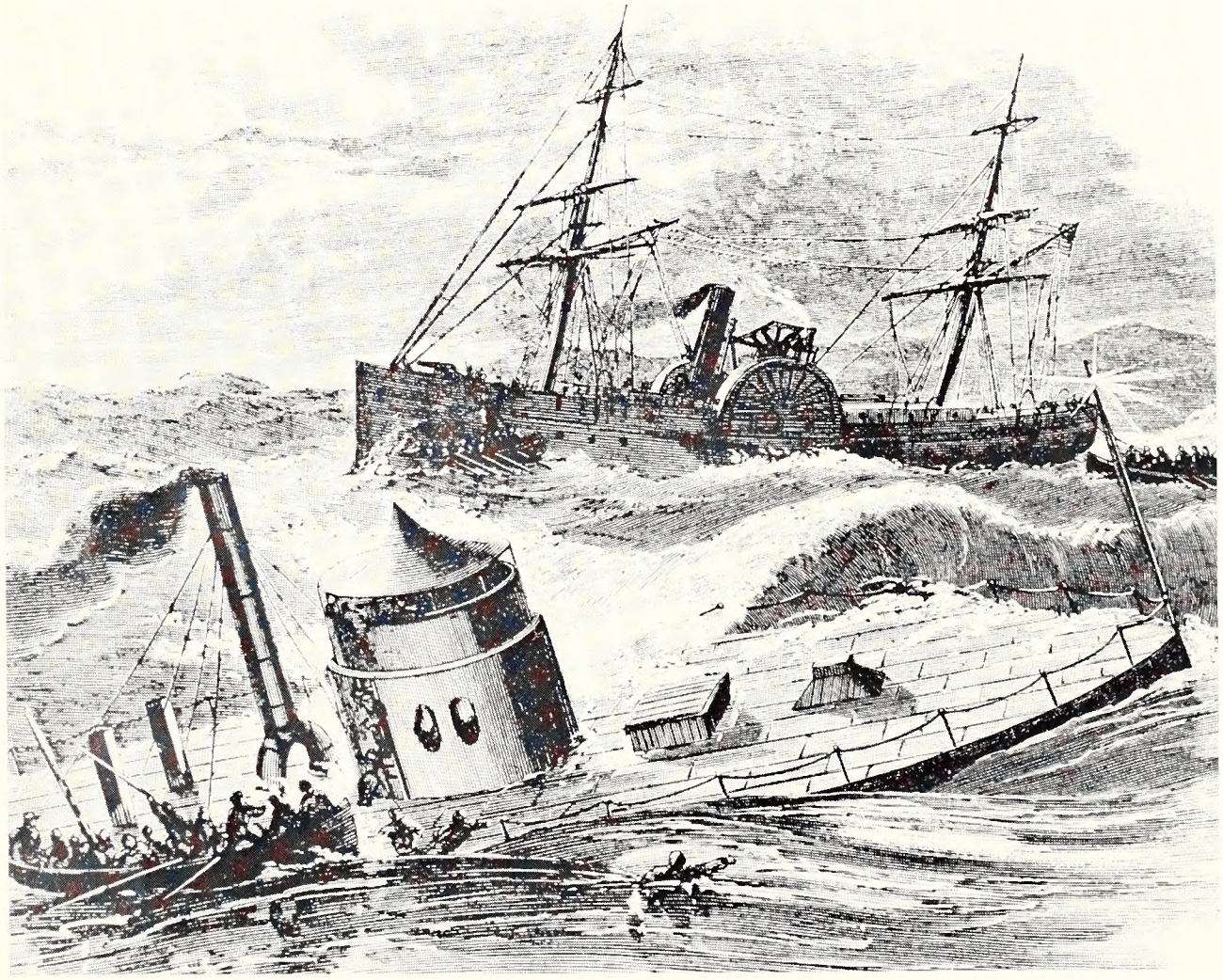


Figure 11. The ironclad rolled sluggishly in heavy swells as boats from the U.S.S. ***Rhode Island*** *labored to save the* ***Monitor's*** *crew.*

LOCATION OF THE SITE

The remains of the U.S.S. *Monitor* lie on the eastern Continental Shelf 16.1 miles south-southeast of the Cape Hatteras lighthouse. Geographical coordinates for the wreck location are 75°24′33″ West Longitude and 35°00′24″ North Latitude *(Figure 12)*.

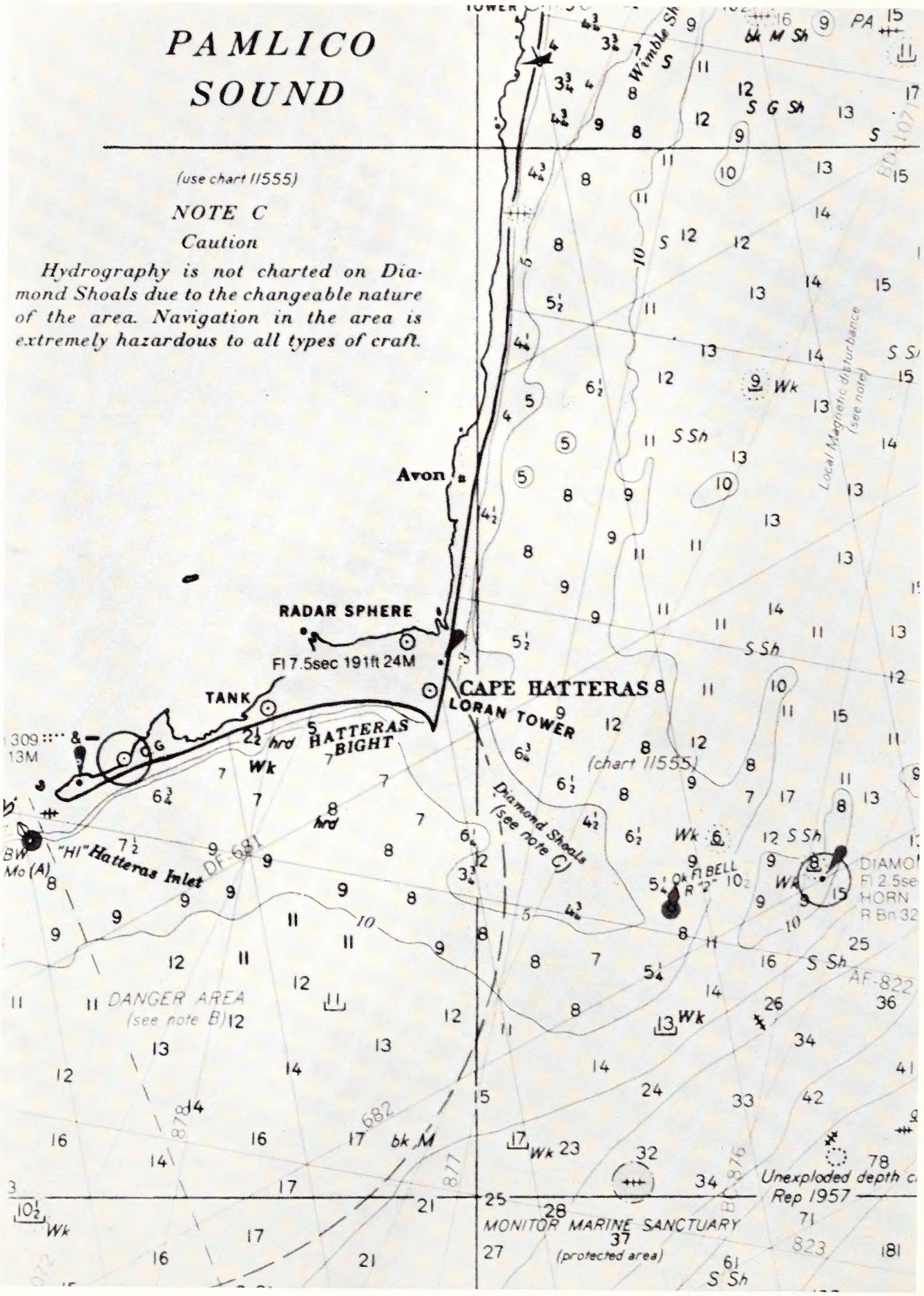


Figure 12. Coast and Geodetic Survey Chart #11555 identifying the location of the Monitor *National Marine Sanctuary.*

MONITOR MARINE SANCTUARY ENVIRONMENT

Water depth in the *Monitor* National Marine Sanctuary varies between 218 and 230 feet, depending upon both specific on-site location and the influence of tidal cycles. Although the site appears to be outside the western margin of the Gulf Stream, eddies created by that current appear to influence directly conditions at the site *(Figure 13)*. Current direction and velocity are variable. Within a twenty-four-hour period, current direction has been observed to change 360 degrees. Current velocities are known to vary from 0.02 knots to in excess of 1.5 knots on the bottom and surface currents appear to be considerably stronger. Both temperature and salinity in the area appear to be related to current patterns. While there is little site-specific data available, temperature projections indicate an annual variation between 11 and 20 degrees Celsius (51.8 and 68 degrees Fahrenheit.)

Figure 13. This National Oceanographic and Atmospheric Administration ERTS satellite photograph dramatically records the Gulf Stream and counter currents in the vicinity of the **Monitor** *National Marine Sanctuary.*

Visibility at the wreck site varies according to turbidity, water temperature, the presence of plankton, and the intensity and angle of sunlight. Observations to date confirm that this generally varies from approximately 10 feet to over 200 feet. However, on one occasion zero visibility conditions were recorded during the presence of extensive amounts of biological material.

In the vicinity of the wreckage the ocean bottom is composed of sand and shell hash at the surface and various sand, shell hash, and clay subsurface strata. A piston core taken outside the *Monitor* National Marine Sanctuary in 1977 revealed nine distinct lenses consisting of sand, various clays, shell hash, and combinations of two or more of these materials *(Figure 14) (Sheridan 1977)*. Bathymetric profiles of the area indicate that the bottom surface slopes gently to the southeast for more than 4 nautical miles before an appreciable grade is evident *(Figure 15)*.

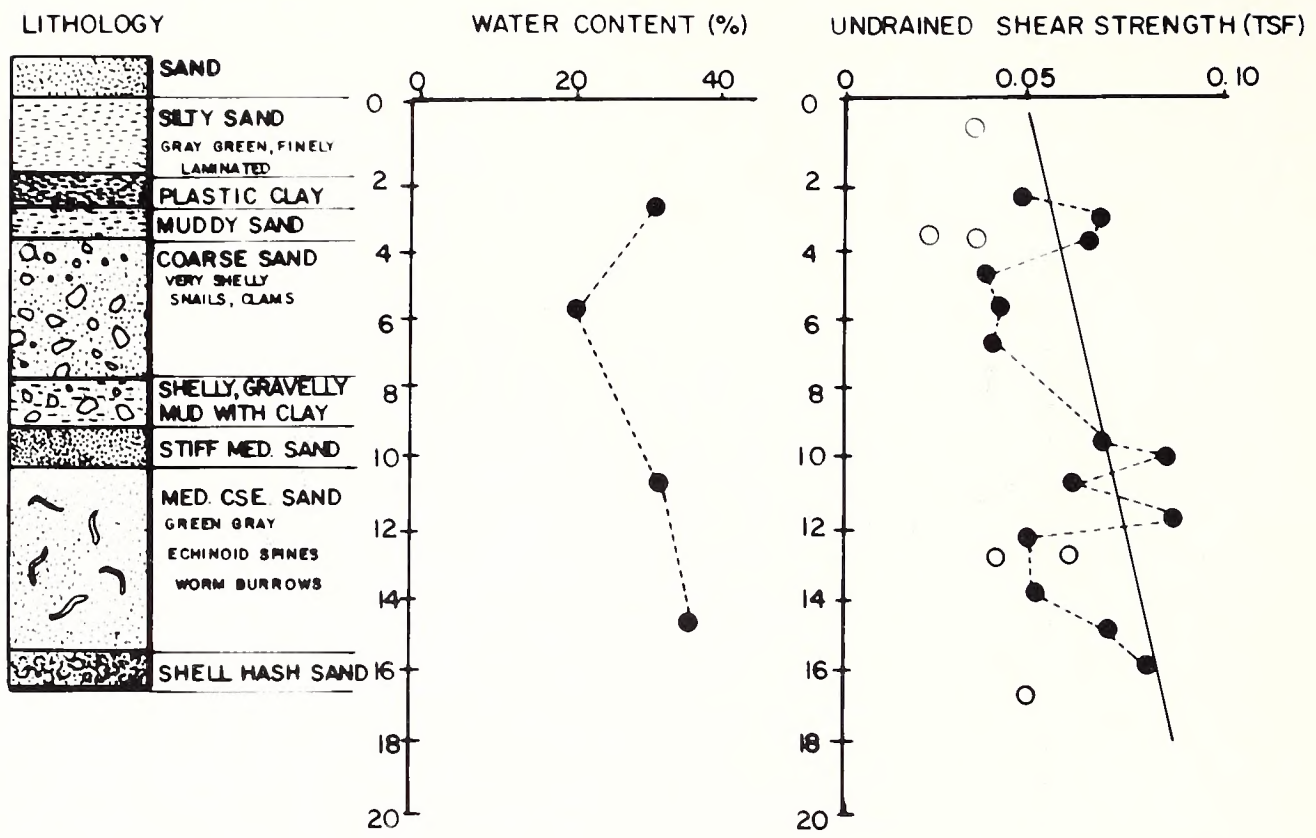
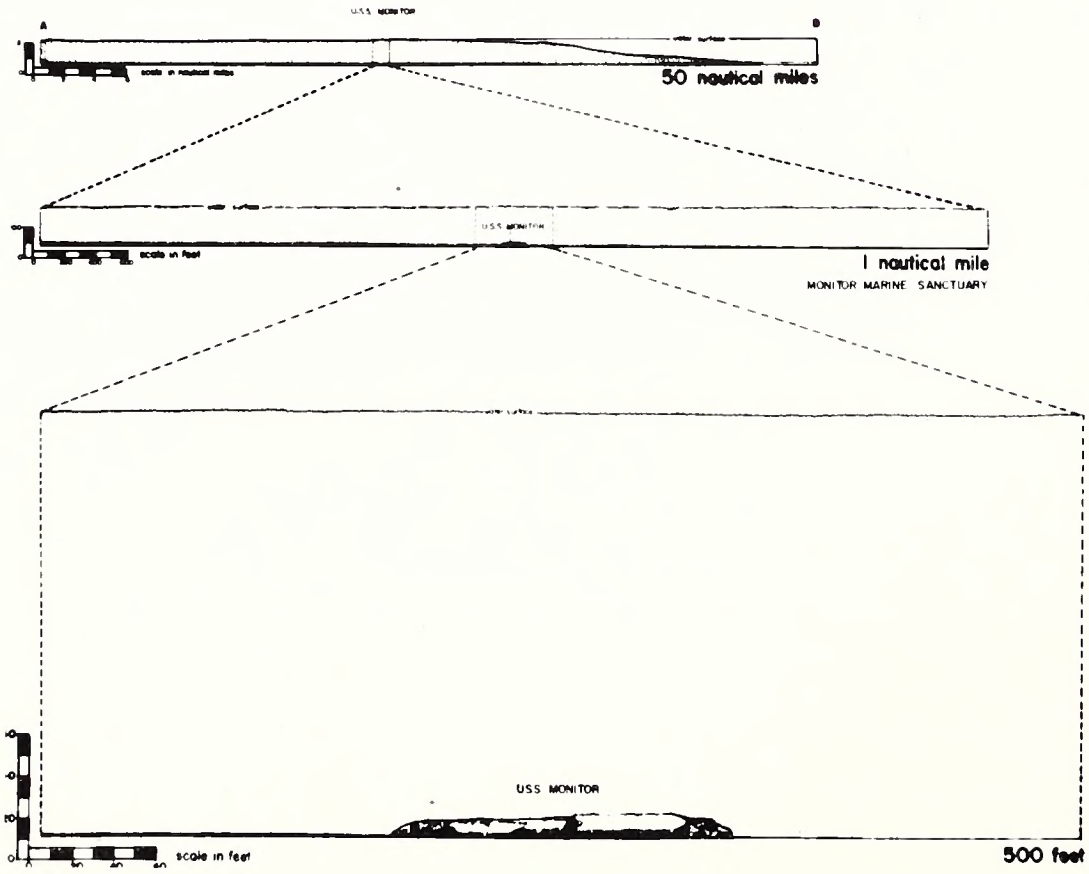
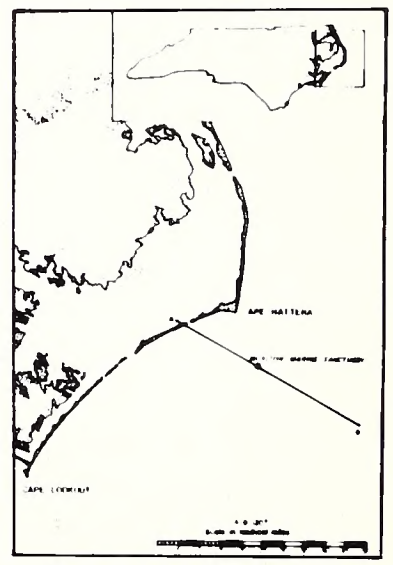


Figure 14. Analysis of a core sample taken just southeast of the remains of the **Monitor** *by Dr. Robert E. Sheridan in April 1977.*





BATHYMETRIC PROFILE THROUGH U.S.S. MONITOR MARINE SANCTUARY

Data Compiled From:

NOAA Navigational Chart No. 12200
Cape May to Cape Hatteras
and
An Oceanographic Atlas of the Carolina Continental Margin /
Duke University Marine Laboratory

Figure 15.

Wind patterns in the area of the *Monitor* National Marine Sanctuary can be generalized as prevailing from the north to west between November and February; south-southwest during July and August; and north-northeast during September and October. However, unpredictable variations have been observed and spontaneous storms frequently occur *(Figure 16)*.

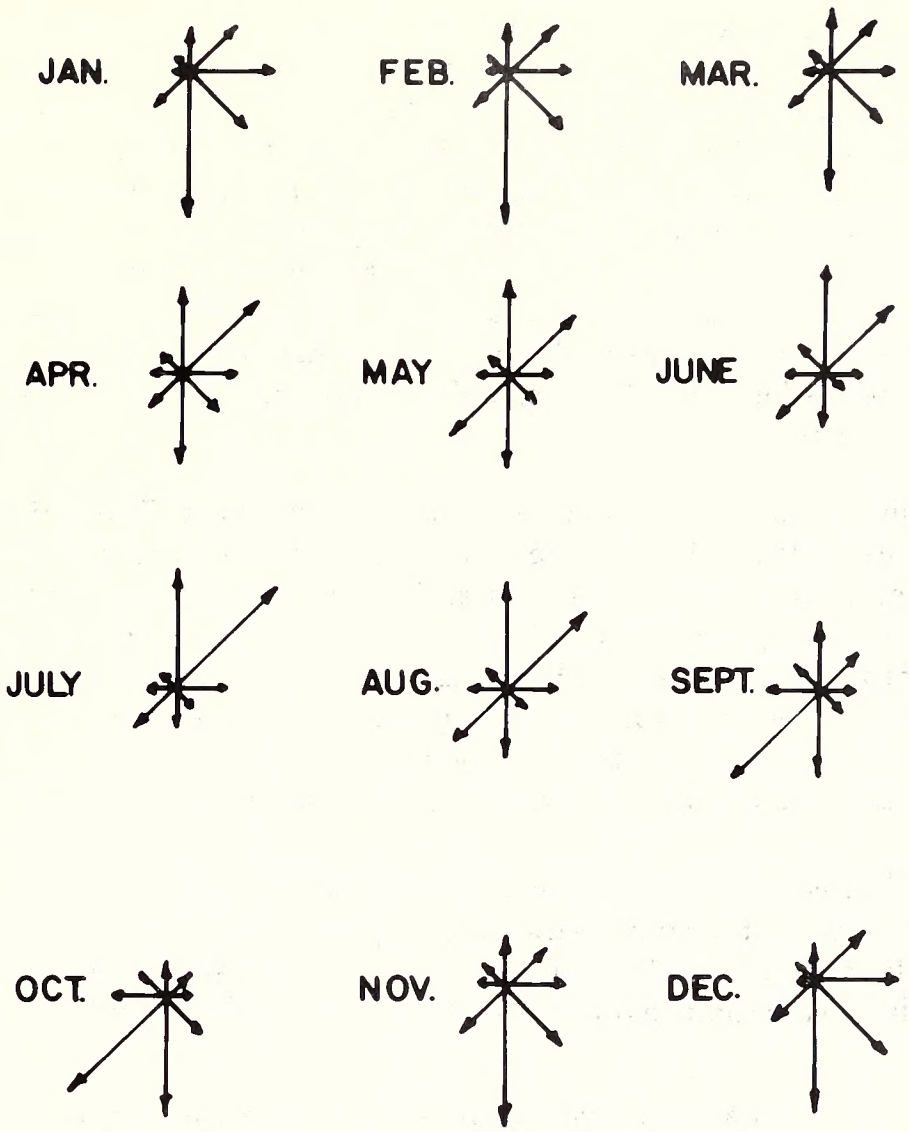


Figure 16. Wind rosettes developed by Rockwell G. Tucker for a 1978 study of the Cape Hatteras environment.

DESCRIPTION OF THE WRECK

The hull of the *Monitor* lies in an inverted position with the port quarter armor belt resting on the displaced turret *(Figure 17)*. The position of the turret and scour settling along the starboard armor belt have combined to elevate the stern and produce an exaggerated list to starboard. The longitudinal axis of the hull lies on a bearing of 290 degrees with the bow to the west-northwest.

Detailed examination of the wreck confirms that the condition of the lower or displacement hull aft of the amidships bulkhead differs dramatically from forward portions of the hull *(Figure 18)*. Bottom plating on the lower hull aft of the amidships bulkhead survives intact where supported by boilers, machinery, and machinery foundations in the engineering spaces. Along both sides of the aft lower hull plating has deteriorated and only the supporting frames remain. In the extreme stern the armor belt has been extensively damaged along with portions of the overhanging deck *(Figure 19)*. Damage to the deck extends from the stern as far forward as the present location of the turret and an extensive amount of armor plate has been dislodged. The rudder skeg and propeller support yoke located aft of the displacement hull have been displaced because of extensive damage to the stern but remain near their original positions supported by the propeller shaft and propeller *(Figure 20)*. Inside the hull the steam propulsion plant, boilers, blowers, pumps, and associated machinery remain relatively intact.

Forward of the amidships bulkhead damage has been more extensive. The entire displacement hull has collapsed. With the exception of the vicinity of the pilot house and limited areas immediately inboard of the port armor belt, plating, associated frames and floors, and other structural iron fragments have covered the interior of the ship *(Figure 21)*. Approximately 50 feet aft of the bow and immediately forward of the amidships bulkhead inboard of the port armor belt, the deck was ruptured, leaving extensive holes in the structure *(Figure 22)*. In these areas and those not obscured by remains of the displacement hull, additional exposed material has been identified as portions of the interior of the vessel, equipment and fittings that were stowed below the crew's quarters and ward room, and associated artifacts.

From the circular anchor well forward of the pilot house structure anchor chain leads over the armor belt and into the sediment toward the south *(Figure 23)*. A series of frames protruding from the sediment identify the location of the armor belt aft of the point where it disappears into the sediment. With the exception of ruptures in the deck structure the armor plate forward of the amidships bulkhead appears to be intact.

Exposed portions of the turret appear structurally sound and exhibit little evidence of deterioration. The gun ports, visible beneath the hull, remain closed by pendulums secured to the interior wall *(Figure 24)*. While the wood floor of the turret has been extensively damaged by toredo and cellular deterioration, it remains structurally intact.

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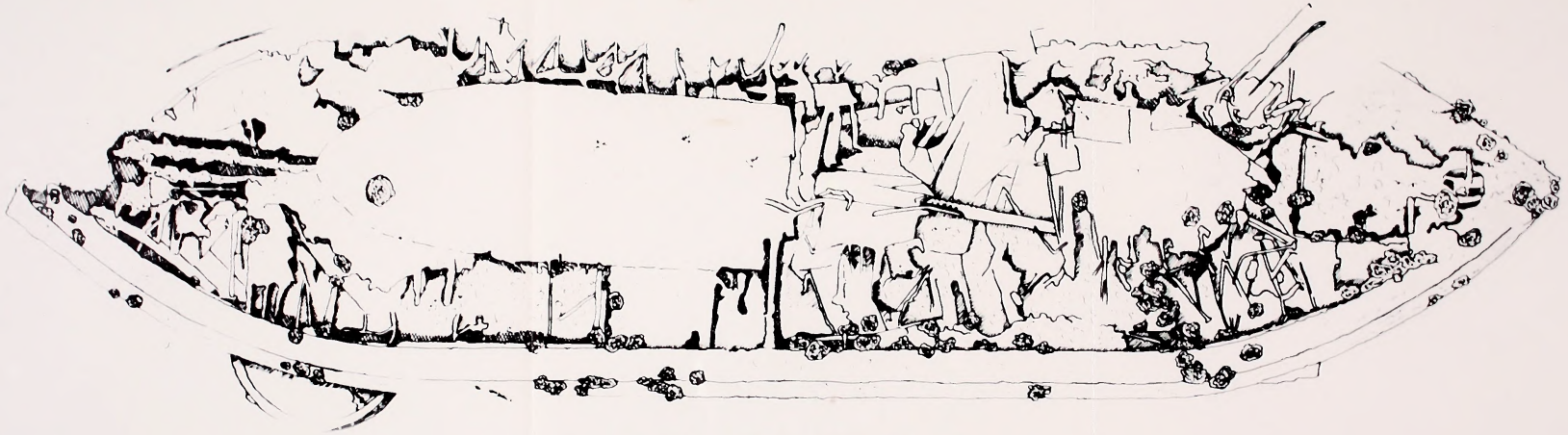


Figure 17. Rendering of the wreckage of the U.S.S. Monitor.

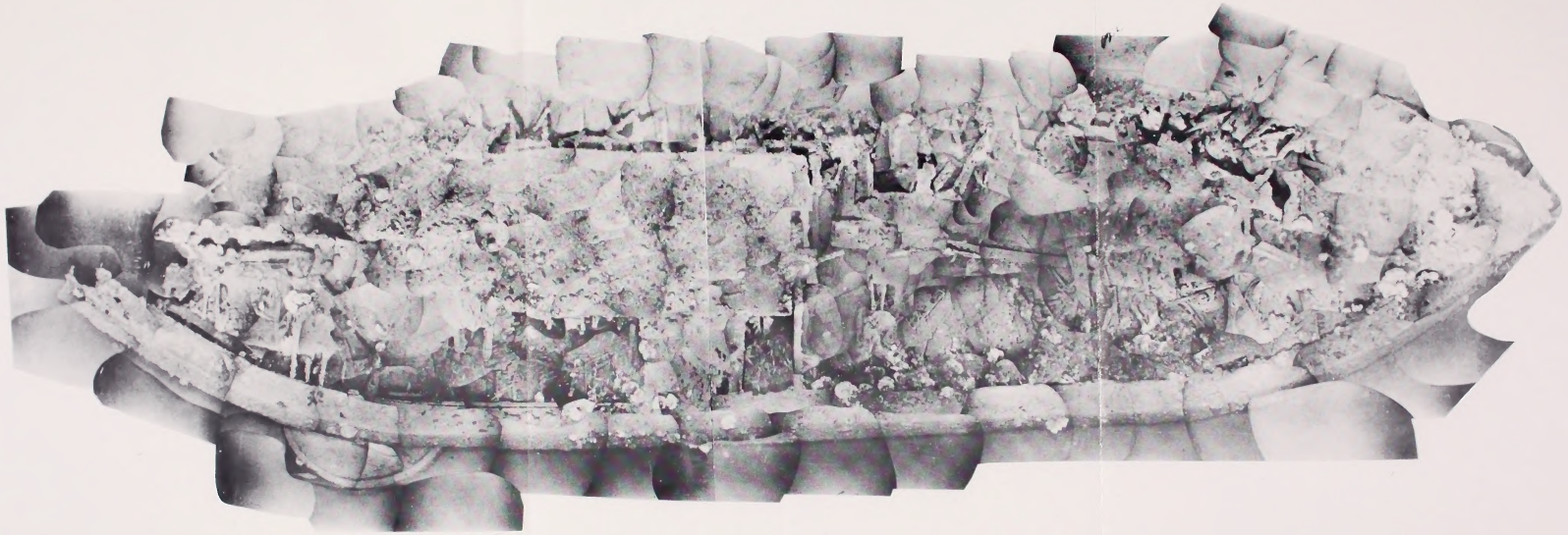


Figure 18. Mosaic assembled from Alcoa Seaprobe photographs by the Naval Intelligence Support Center.

Figure 19. Aft of the present location of the turret, both the port (above) and starboard armor belts have been extensively damaged.

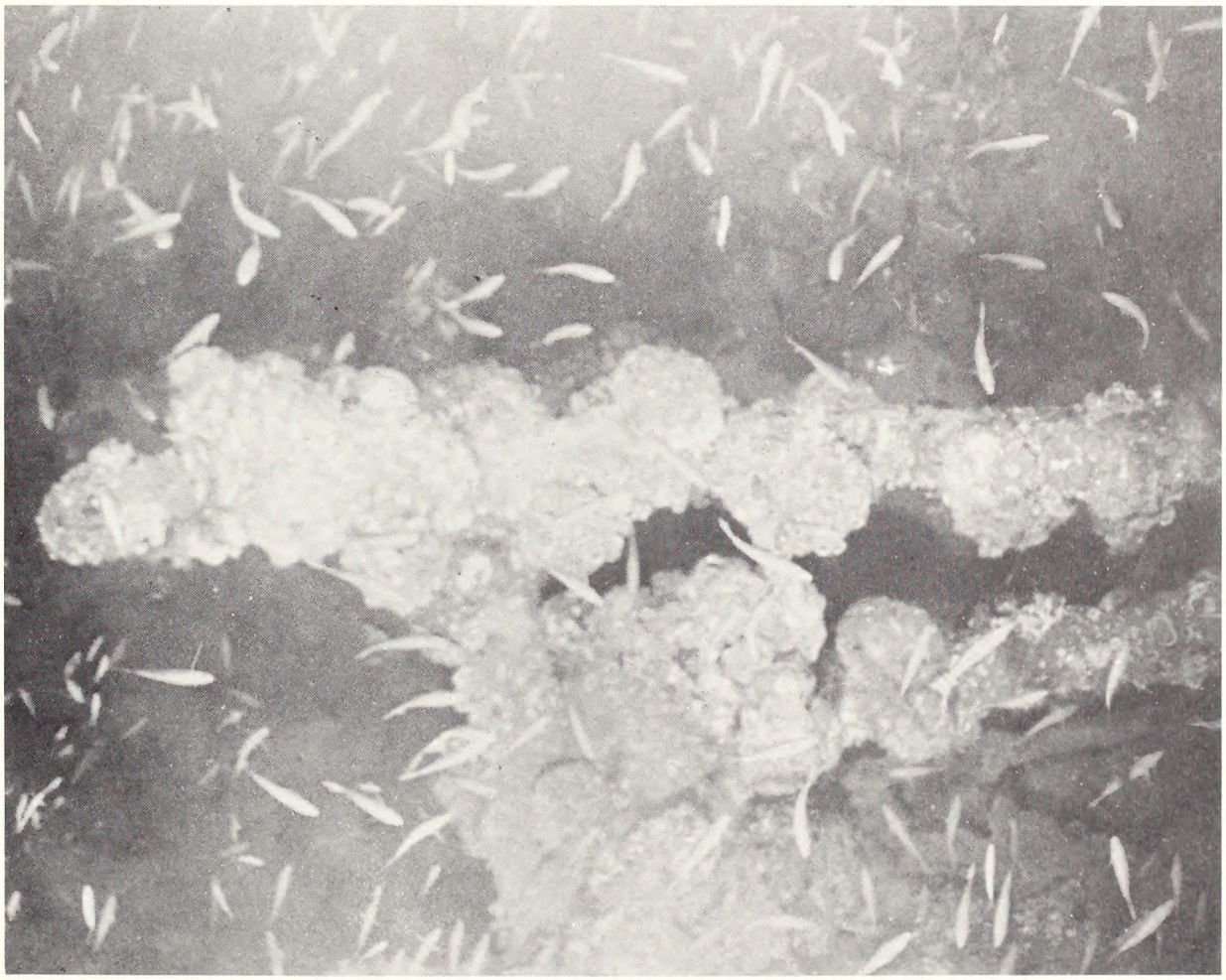


Figure 20. Although displaced by damage to the stern and obscured by heavy fouling the propeller, propeller support yoke, and skeg survive intact.

Figure 21. Forward of the amidships bulkhead, structural material from the lower hull has collapsed to cover the interior of the wreck.

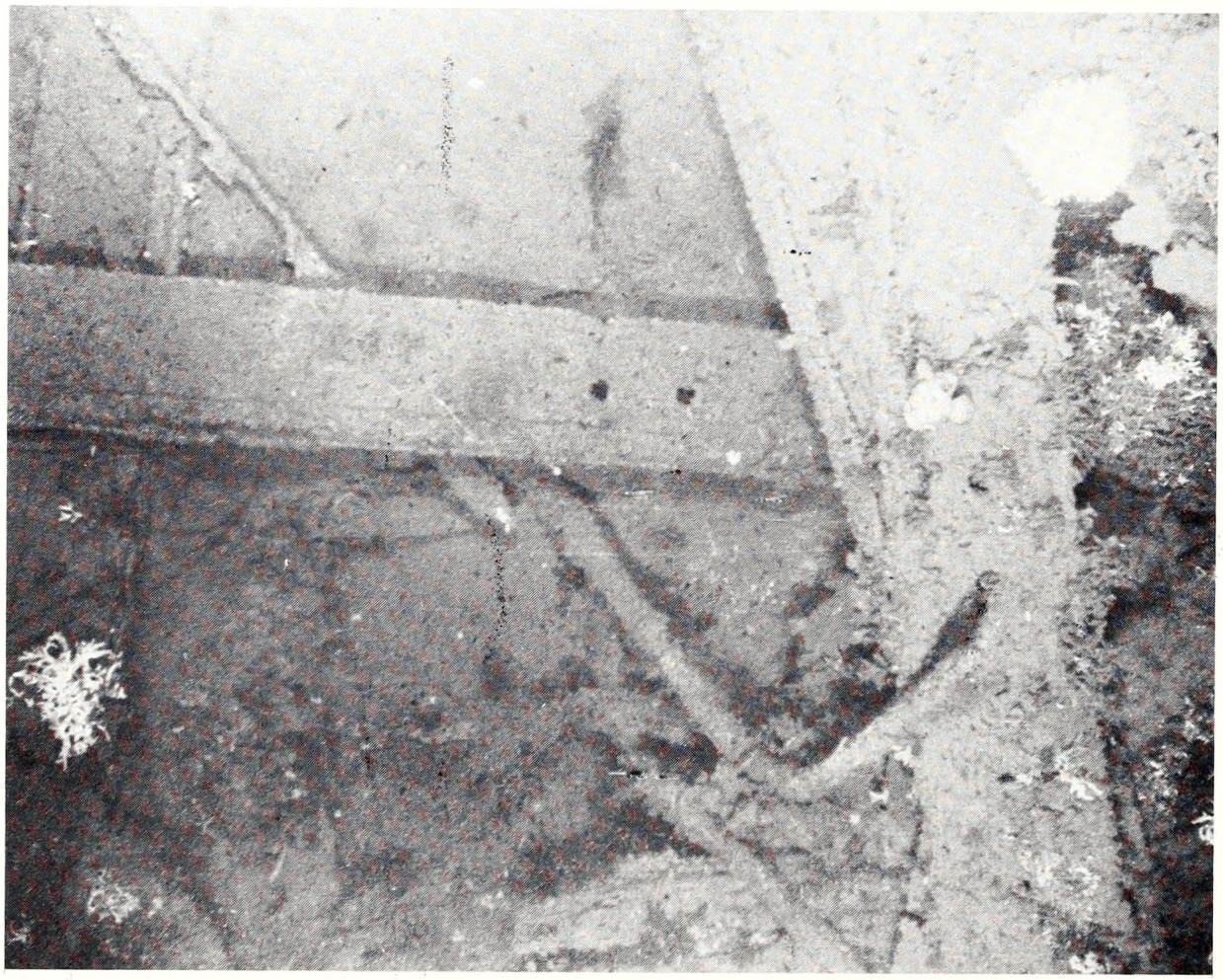


Figure 22. Below displaced "floors" the wardroom deck has ruptured to reveal sediment below the remains of the **Monitor**.

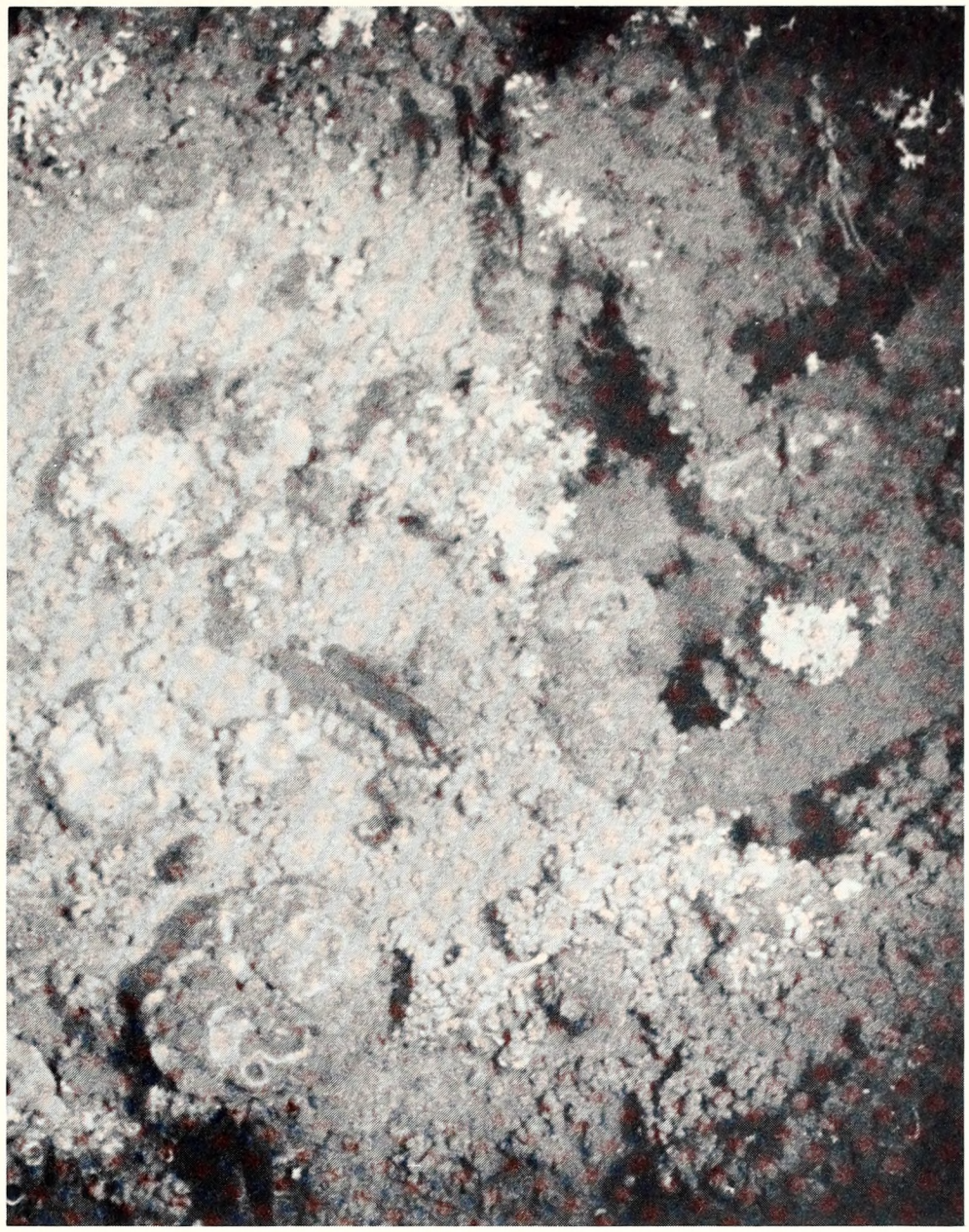


Figure 23. Heavily concreted anchor chain from the **Monitor***'s distinctive circular anchor well leads across the underside of the starboard armor belt and into the sediment south of the wreckage.*

Figure 24. The turret, dislodged in sinking, lies partially exposed below the port quarter armor belt.

SITE PROTECTION AND MANAGEMENT

Public announcement of the location and identification of the *Monitor* in March, 1974, focused renewed attention on the celebrated warship and generated extensive public interest in the continued investigation and possible salvage of the wreck. The announcement also stimulated considerable interest in protecting the fragile remains of the *Monitor* among preservation-conscious organizations and governmental agencies. The emphasis of activity during this period was directed toward identifying and developing a legal vehicle for protecting the site from looting or attempted salvage until scientific plans for the investigation and development could be formulated.

After prolonged investigation of applicable legislation throughout the spring and summer of 1974, the *Monitor* was determined to be eligible for nomination to the National Register of Historic Places on June 14, 1974. Nomination to the National Register was made by the North Carolina Division of Archives and History and accepted on October 11, 1974. In addition, the governor of North Carolina nominated the *Monitor* for consideration as a National Marine Sanctuary under the Marine Protection, Research and Sanctuaries Act of 1972. On January 30, 1975, nomination proceedings culminated in the designation of the vessel's Continental Shelf location as the United States' first National Marine Sanctuary. Since that designation, the National Oceanic and Atmospheric Administration (NOAA) and the North Carolina Department of Cultural Resources have cooperated to develop responsible policies for preservation, research, and management of the *Monitor*.

While designation of the *Monitor* National Marine Sanctuary provided a legal vehicle for protecting the site and delegated responsibility for management to NOAA, no system existed for reviewing research proposals or preparing guidelines for research and development. As applications for research permits were

being prepared while the nomination was being studied, a system for reviewing the merits of proposals for work at the site became one of the first management priorities. In conjunction with the Underwater Archaeology Branch of the North Carolina Division of Archives and History, the staff of NOAA's Office of Coastal Zone Management began to formulate a responsible approach to the problem. In light of the complex multidisciplinary nature of anticipated research, both agencies agreed that decisions to approve or deny permits should be made with the advice and recommendations of recognized authorities in fields related to investigation of the ship *(Figure 25)*.

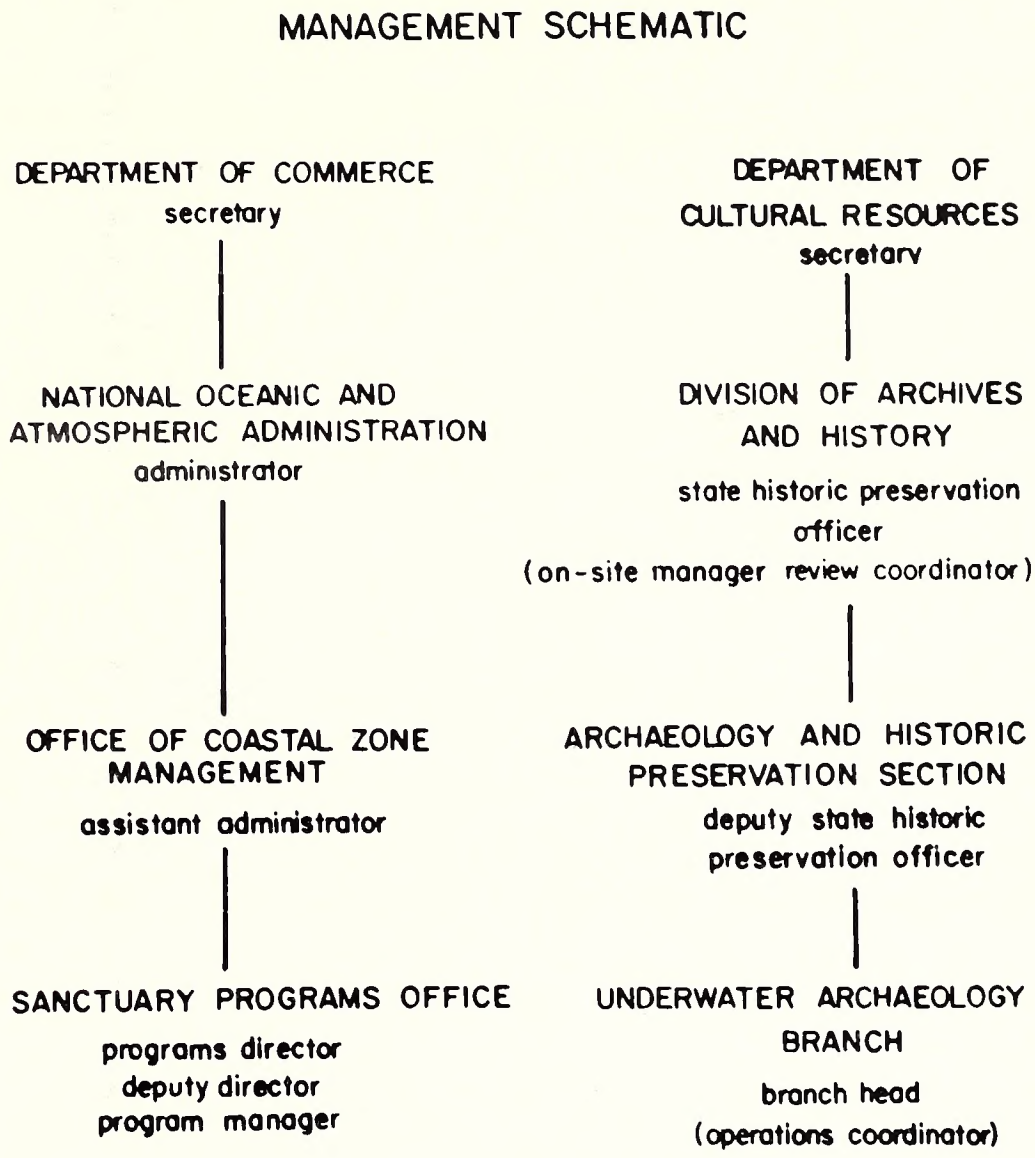


Figure 25.

To generate input into the decision-making process, each proposal would be evaluated by members of two separate review committees. The first, designated the Technical Advisory Committee, was to be composed of authorities in such disciplines as underwater archaeology, naval and maritime history, conservation, engineering, oceanography, geology, and museology. Their responsibility would be to examine, evaluate, and make recommendations concerning the technical aspects of proposed research. A second advisory council, designated the Governmental Review Committee, would be composed of representatives from agencies and institutions having expertise or authority in such fields as maritime law, historic preservation, history, archaeology, technology, and museology. Members from participating agencies and institutions such as the Smithsonian Institution, National Trust for Historic Preservation, Office of Archaeology and Historic Preservation, and the United States Navy would review each proposal and evaluate the impact of proposed research in terms of developing the remains of the *Monitor* in the best interest of the American public. With recommendations from both advisory committees, NOAA would render a final decision to approve, recommend revision, or deny each application.

Once the advisory committees and proposal and review criteria were established, attention was focused on the formulation of guidelines for research that would ensure that the most desirable long-term options for development of the *Monitor* would not be compromised.

In response to the need for guidelines set forth in a series of meetings called to discuss the *Monitor*'s future, the North Carolina Division of Archives and History agreed to coordinate the preparation of a master planning document for the *Monitor* National Marine Sanctuary. The Underwater Archaeology Branch was delegated responsibility for the development of the master planning document and served as a nucleus for consolidating and refining information from federal, state, and local agencies, institutions, foundations, museums, and an extensive group of archaeologists, naval and maritime historians, engineers, museologists, oceanographers, and conservators. By March, 1979, the document had been refined to identify basic research goals and development options.

To ensure that the remains of the *Monitor* would be preserved for development in the best interest of the American people, a research philosophy committed to two primary goals was adopted. The first was to assure the scientific recovery and dissemination of the historical and cultural information preserved at the wreck site. The second and equally important goal was the preservation and development of the physical remains of the *Monitor* in a manner that enhanced both the significance and potential of the warship. To accomplish these goals, the planning document included a four-phased approach to continued research designed to identify the most appropriate and feasible research and development option and provide the data necessary for making responsible decisions concerning those options. Once amended to include revisions suggested in a national conference sponsored by the Smithsonian Institution on October 23, 1978, the "*Monitor* Marine Sanctuary Research and Development Concept" was approved by the Technical Advisory Committee on March 5, 1979. Even before the final acceptance of the document, NOAA and the North Carolina Division of Archives and History were committed to supporting those research objectives identified in the process of developing the master document.

During 1978 a series of historical, engineering, and oceanographic research contracts were initiated by the North Carolina Division of Archives and History to define the data base related to the *Monitor*. In addition to evaluating our present knowledge of the site, the studies were designed to identify additional material and information that would be essential in making decisions related to the selection of options for development of the site. Based on these studies and research needs identified in the course of preparing the master planning document, ambitious investigation of the *Monitor* was planned for the summer of 1979. With a firm commitment from Harbor Branch Foundation for support vessels, planning for the project began in earnest in the winter of 1979.

Objectives for research at the site for the 1979 operations were adopted from priorities identified during the preparation of the "*Monitor* Marine Sanctuary Research and Development Concept" and studies that had been initiated by the North Carolina Division of Archives and History. Archaeological objectives included establishing the nucleus of a permanent datum system designed to provide controls for work on the wreck, the conduct of a test excavation inside the confines of the hull, and a general examination and assessment of the site. Historical and engineering objectives included additional photographic and video documentation under and inside the wreck and recovery of samples to provide insight into the condition of the vessel remains. Details of the proposed work were spelled out in an extensive operations manual prepared by NOAA and the North Carolina Division of Archives and History. While the participation of NOAA precluded the necessity for securing a permit for the research, the operations manual was circulated for review and comment and approved through the same channels established for proposals.

PREVIOUS ON-SITE RESEARCH

Investigations in what is today the *Monitor* National Marine Sanctuary began on August 27, 1973, when an interdisciplinary scientific party aboard the R/V *Eastward (Figure 26)* located the heavily damaged remains of the sunken ironclad. The location and subsequent identification of the vessel were the result of a two-week research project supported by the National Science Foundation, Duke University, the North Carolina Division of Archives and History, Massachusetts Institute of Technology, the University of Delaware, the National Geographic Society, and the United States Army Reserve. The project included both geological and archaeological objectives. The first of these was a geomorphic investigation into the origins of a ridge and swale feature located on the Continental Shelf 12 miles south of Ocracoke Inlet. The second objective was to explore the potential for adapting oceanographic tools and techniques to locate and identify deepwater shipwreck sites on the Atlantic Continental Shelf *(Figure 27)*.

Because of time and geographical considerations, the decision was made to limit the scope of the archaeological investigation to the location and identification of one specific historically documented sinking in the vicinity of the geomorphic study. While historical research revealed a variety of well-documented sinkings in the area immediately south of Diamond Shoals, only the *Monitor* represented a site of considerable historical and technological significance. In addition, sufficient primary source research material survived to permit the approximate location of the vessel's last known position to be established. To accomplish this, a comprehensive effort was made to evaluate both the historical source material and extant environmental data.

In spite of numerous inconsistencies and frequent navigational discrepancies, Civil War naval records provided the only credible source of data related to the loss of the *Monitor*. Of those records the chart logs of the tow-ship U.S.S. *Rhode Island*, the steamer U.S.S. *State of Georgia*, and the monitor U.S.S. *Passaic* proved to be the most valuable. These records preserved the basic information regarding speeds, bearings, soundings, and occasional positions that made replotting of the *Monitor*'s final voyage possible. Equally important, they contained a meticulous record of wind direction and velocity, barometric pressure, and water temperature. This information made it possible to reconstruct critical environmental conditions during the voyage. Additional useful information was found in the records and correspondence of the captains and crews of both the *Monitor* and *Rhode Island*.

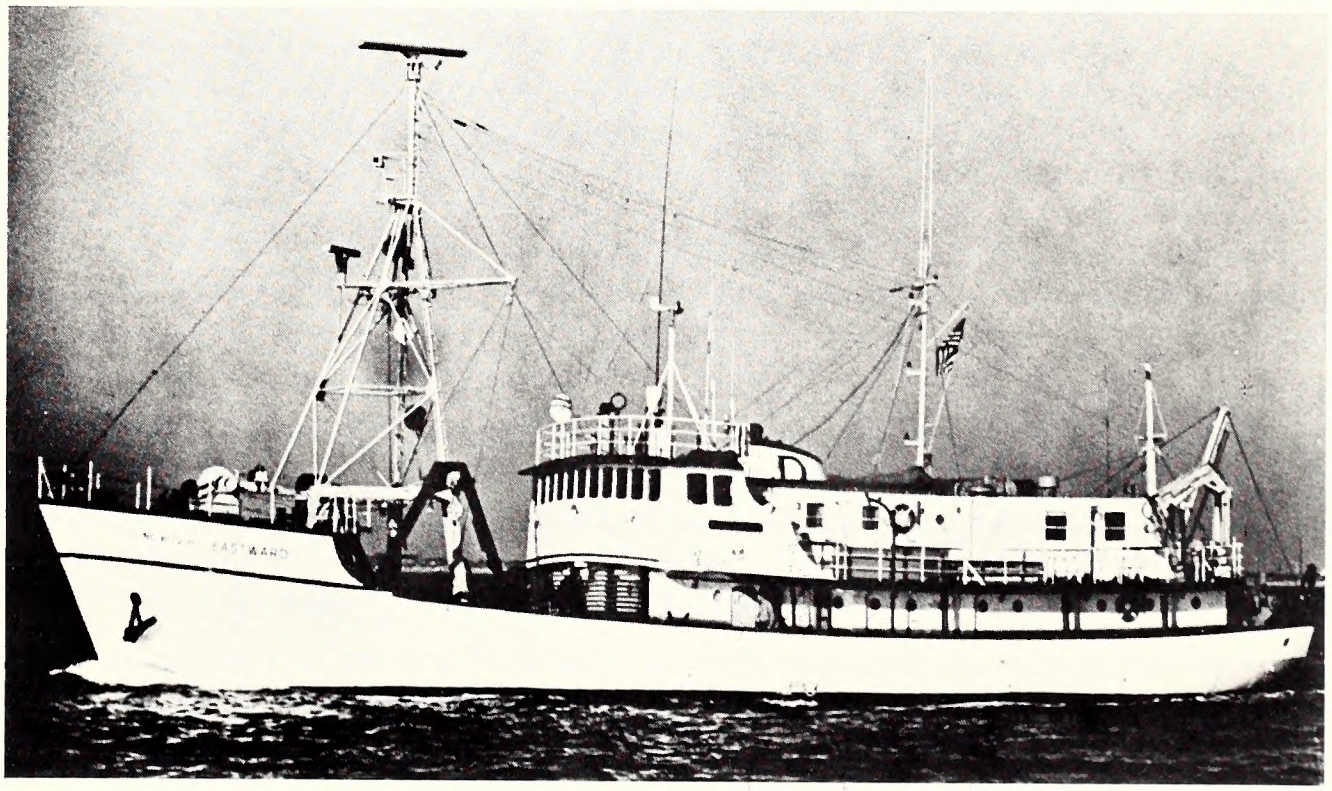


Figure 26. The Research Vessel **Eastward**, *utilized in the cruise that resulted in the location of the remains of the U.S.S.* **Monitor**.

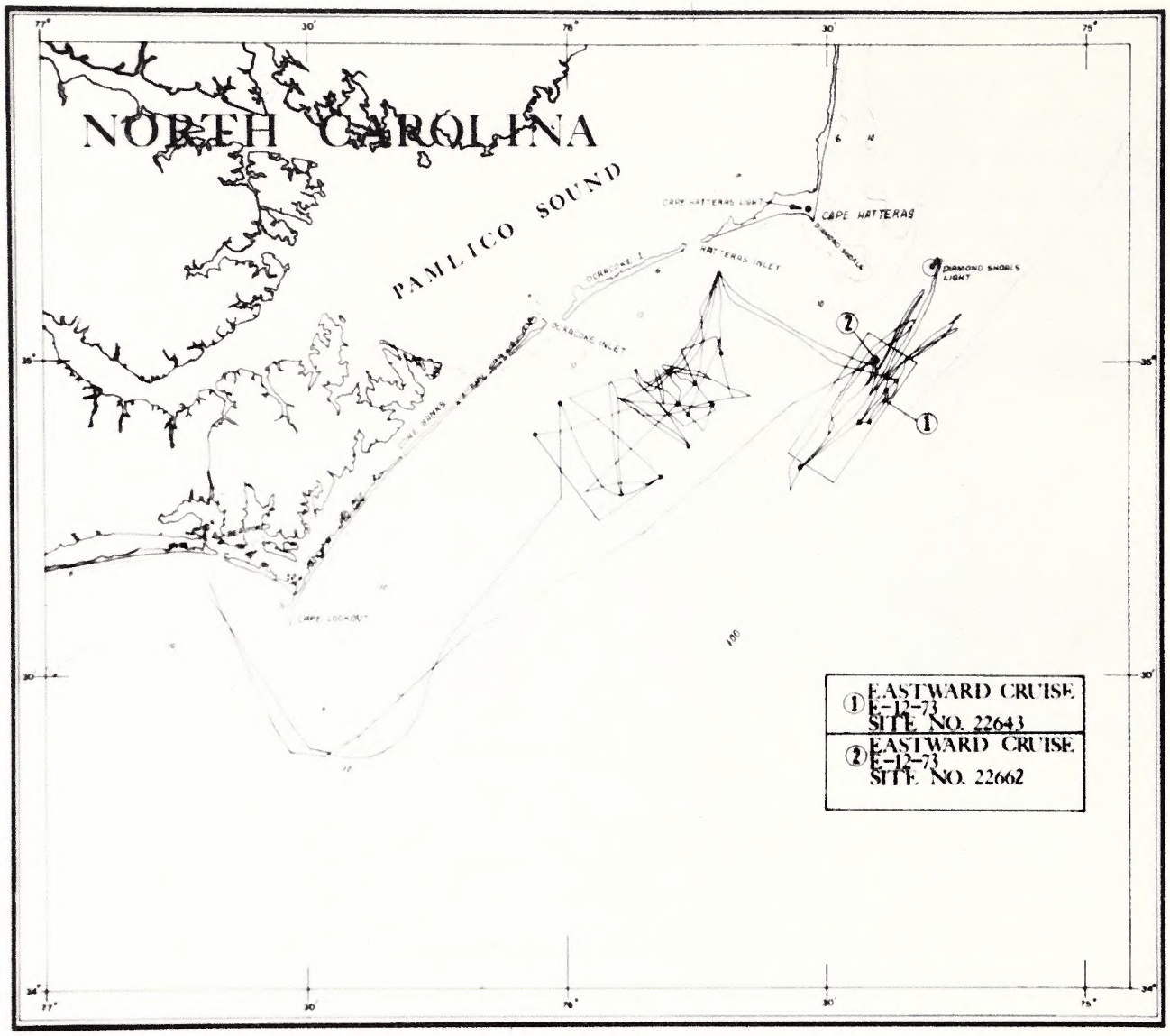


Figure 27. Cruise chart for the 1973 R/V **Eastward** *project.*

By combining this information with current bathymetric data and what is known of the influence of the Gulf Stream, it was possible to calculate a maximum and minimum potential effect for each of the variables suspected to have been responsible for the frequent time, distance, and position discrepancies in the logs. While it was possible that some of these contradictions were related to the strong local magnetic disturbances in the Hatteras area, no satisfactory method for gauging their influence could be determined. Reconstruction of the environmental conditions made it possible for "set" and "drift" to be estimated during the critical period after the *Monitor* and the *Rhode Island* separated.

Additional adjustments were made to compensate for the natural annual variation in magnetic north and the mid-nineteenth century location of the Hatteras light. After consulting an 1857 chart for additional bathymetric information, the data was plotted on a series of Coast and Geodetic Survey charts of the North Carolina coast. The result was a 5-mile-by-4-mile rectangle, hypothetically the area of highest probability *(Figure 28).* Although on-site observations of the area currents gathered during the cruise made revisions necessary, the technique proved to be of considerable value in isolating the search area.

During the project a total of twenty-two wreck sites were located in the search area. This was accomplished using a combination of conventional vertical sonars, Simrad Basdic directional sonar, EG & G side scanning sonar, and a Varian proton precession magnetometer. This combination provided both an indication of the magnetic intensity of the target and an acoustic indication of its physical dimensions *(Figure 29).* In the area of the search a hard, relatively stable, and virtually featureless sand bottom provided ideal conditions for the use of both acoustic and magnetic remote sensing equipment.

Remote sensing sweeps were run parallel to the bottom contours, which are generally aligned southwest to northeast in the area of the search. This additional bathymetric control greatly facilitated maintaining a consistent search pattern. Anomalies located on each sweep were plotted with data provided by a combination of electronic navigation equipment including Omega, Loran A and C, radar, and Del Norte. Of these systems only the latter provided the positioning accuracy necessary for effective surveying. The system consisted of a series of transponders located on top of both the Cape Hatteras lighthouse and the Diamond Shoals tower, which is located at the outer extremity of the shoals. These were keyed to a receiver aboard the research vessel that provided a continuous digital readout of the distance from each position. This information made highly accurate trilateration possible. To assure accurate relocation, sites were plotted on Coast and Geodetic Survey charts, and the coordinates from each of the positioning systems were recorded.

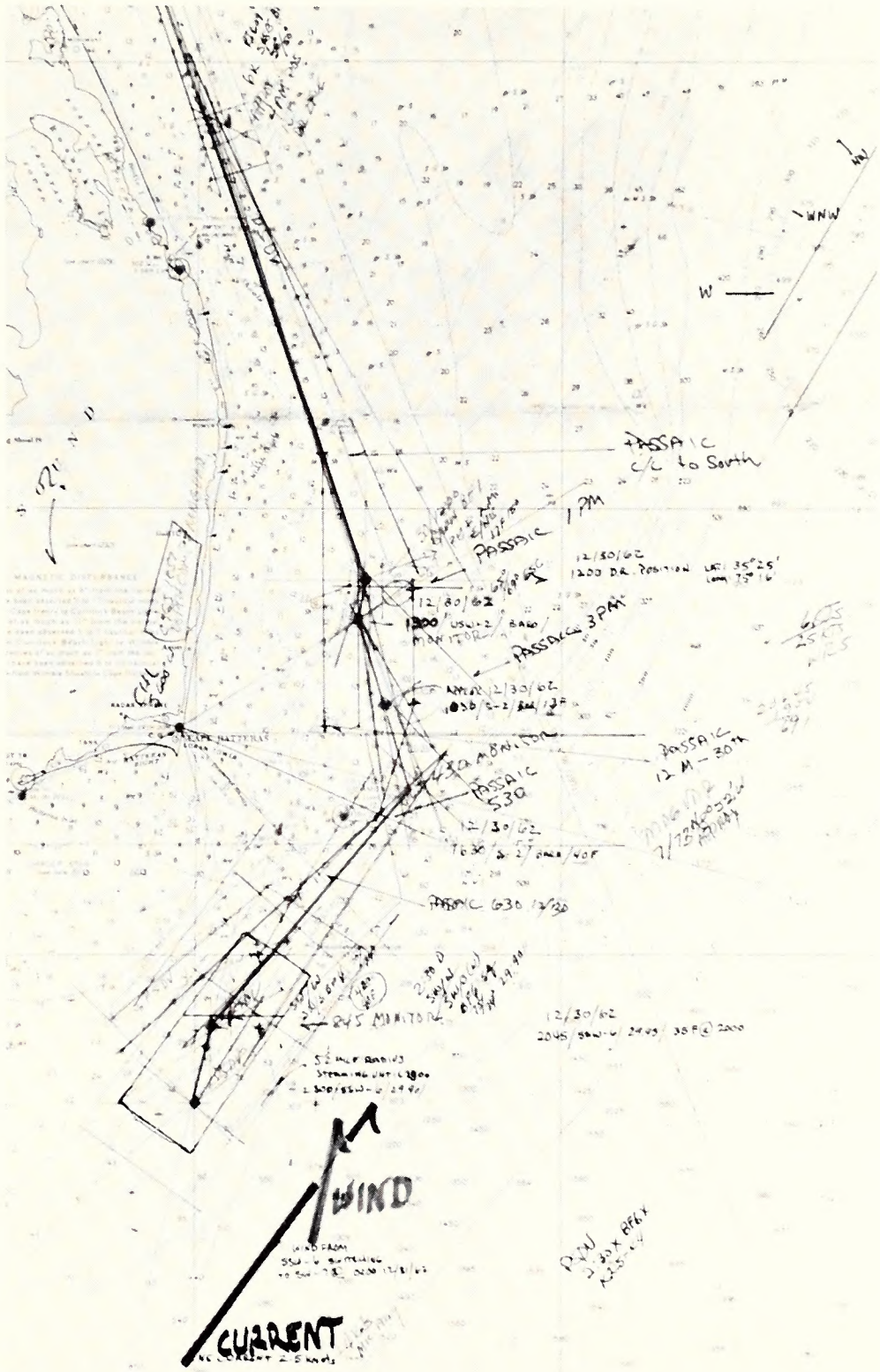


Figure 28. One of several charts employed to plot the Monitor's final voyage and determine the search area of highest probability.

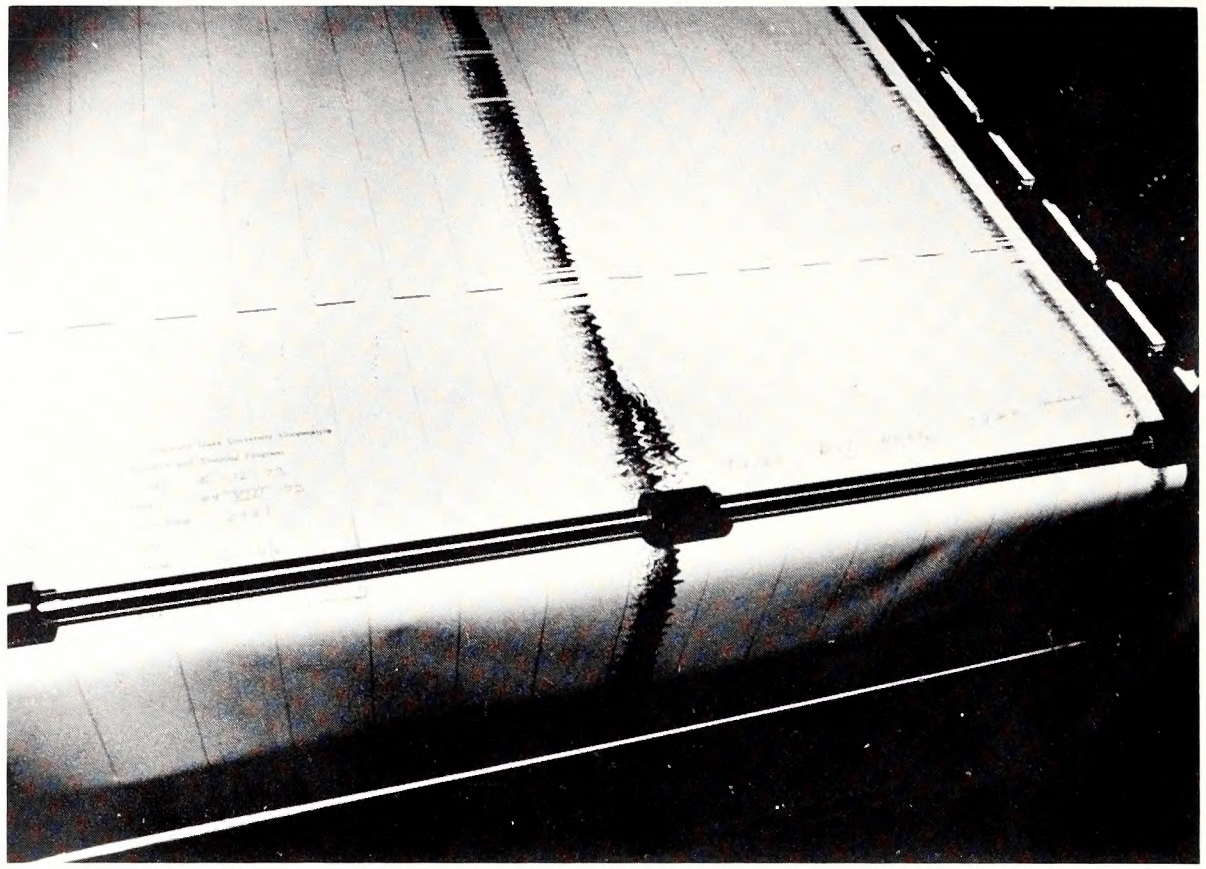


Figure 29. The **Monitor***'s signature recorded on the R/V* **Eastward***'s precision depth recorder in August 1973.*

Wreck sites located and recorded in this manner were then evaluated according to length, relief, and the intensity of their magnetic signature *(Figure 30)*. Those that obviously did not conform to the projected characteristics of the *Monitor* were recorded and eliminated. Those that corresponded or were smaller in length, relief, and magnetic intensity than what was projected for the vessel were examined further with a 35 mm. oceanographic camera *(Figure 31)* and a low light level closed circuit television system. Permanent television tape records were made on a 1-inch recorder *(Figure 32)*.

Of the twenty-two sites located during the investigation, only two generating magnetic and acoustic signatures that corresponded to a projected signature for the *Monitor* were examined visually. The first of these was identified as a modern patrol boat and eliminated during the cruise. The second, although badly deteriorated, exhibited several features that corresponded closely to known details of the *Monitor*'s construction. Most immediately apparent was the existence of a distinct overlapping lip that closely resembled the armor belt of the ironclad. Several camera passes recorded a cylindrical feature partially obscured by the vessel's hull *(Figure 33)*. Preliminary measurements of the structure made from the television monitor confirmed that it corresponded in size to the specifications of the *Monitor*'s turret. This evidence was considered sufficient to merit spending the remainder of the cruise collecting additional data at the site *(Figure 24)*.

The majority of the data collected during the R/V *Eastward* cruise was in the form of random photographic and television tape records. Analysis and identification of the sites proved to be a cumulative process. First, small photomosaics of the significant features of the wrecks were constructed. These were carefully related to drawings of the sites that were produced from the videotape and photographic data. This technique tied the individual camera passes together in the form of a composite picture.

While Ericsson's correspondence indicated that the specifications of the vessel were the subject of almost continuous adjustment, the external design and basic features of the *Monitor* remained essentially unaltered. By relying on the sources either directly involved in the construction or actively engaged in the operation of the vessel, it was possible to establish an acceptable framework within which significant comparison could be made.

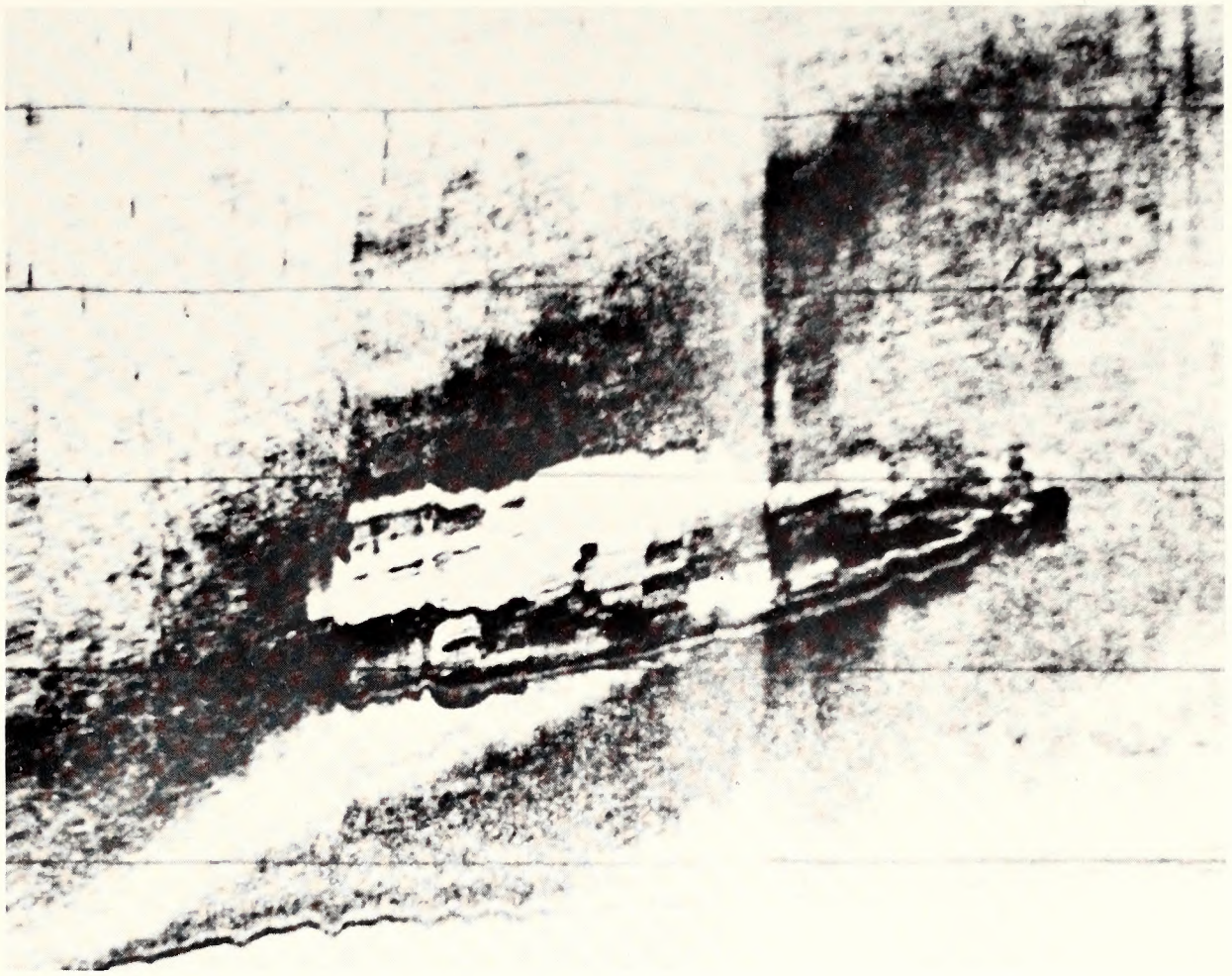


Figure 30. Side scan sonar image of the **Monitor** *produced by Dr. Harold Edgerton in 1977. The port armor belt and turret are clearly visible, and the white shadow beyond the wreck recorded the configuration of the skeg and propeller shaft.*

Figure 31. A 35 mm. EG & G oceanographic camera was employed by scientists aboard the R/V **Eastward** *to collect the first photographs of the* **Monitor**.

Figure 32. Television monitors and a recorder located in the **Eastward***'s wet laboratory permitted permanent video tape records to be made and details of the wreckage to be studied on-site.*

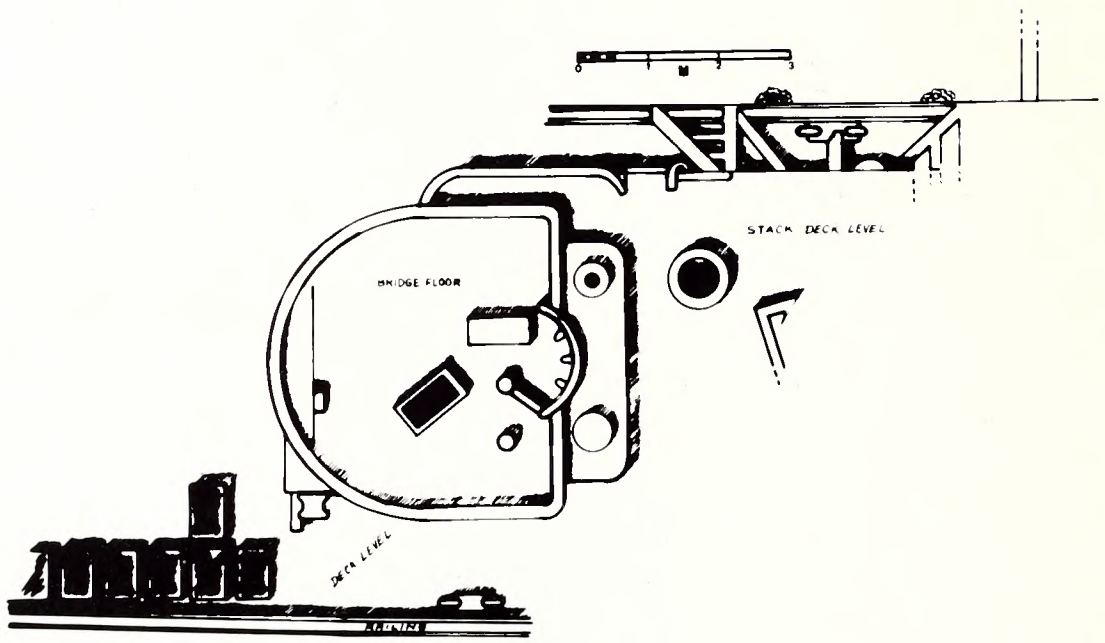
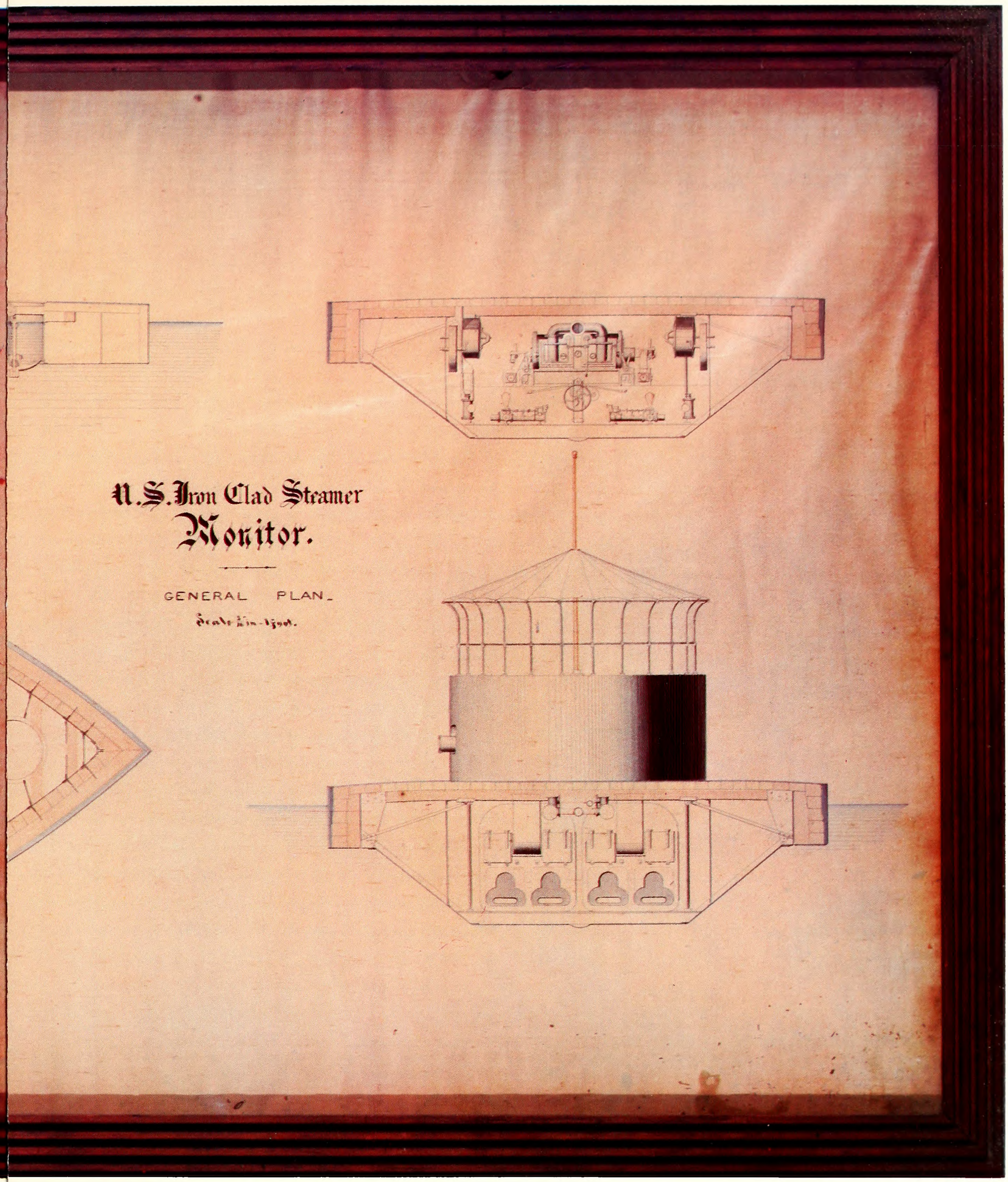


Figure 33. Rendering of Target No. 22643 fr from the R/V **Eastward** *on August 26, 1973*

Detailed analysis of the available historical sources confirmed that the design of the *Monitor* remained unique even among the later classes of turreted, heavily armored, low freeboard vessels that were built in the United States. Although many of the characteristics that combined to make the *Monitor* unique were utilized in later vessels, their designs were unquestionably altered from their original forms. This comparative historical analysis isolated a series of distinguishing characteristics that would be reliable criteria for identifying the vessel *(Figure 34)*.

Because of their massive construction the turret, pilot house, and armor belt were anticipated to be readily identifiable regardless of the physical condition of the site. Likewise, the vessel's unusual propeller, skeg, and rudder arrangement were considered to be reliable keys to the *Monitor*'s identity. At the bow the unique anchor well that penetrated the projecting armor platform and the distinctive four-fluked anchor were singled out. It was also felt that the unusual configuration of the lower hull would prove to be a useful factor in the identification process. In an effort to save both construction time and costs, Ericsson designed the lower hull of the vessel with a virtually flat bottom, extremely hard chine *(Figure 35)*, and flat sides that rose to the inside of the bottom of the overlapping lip of the armor belt. The extremely bluff bow and stern were plated vertically, while the plating of the lower hull ran athwartships rather than longitudinally as had generally been the custom. This configuration and plating technique minimized the expensive and time-consuming necessity for bending plates to obtain a more sea-kindly and conventional hull design. Although there were additional details, these criteria formed the nucleus for the visual evaluation of the sites


U.S. Iron Clad Steamer
Monitor.
GENERAL PLAN.

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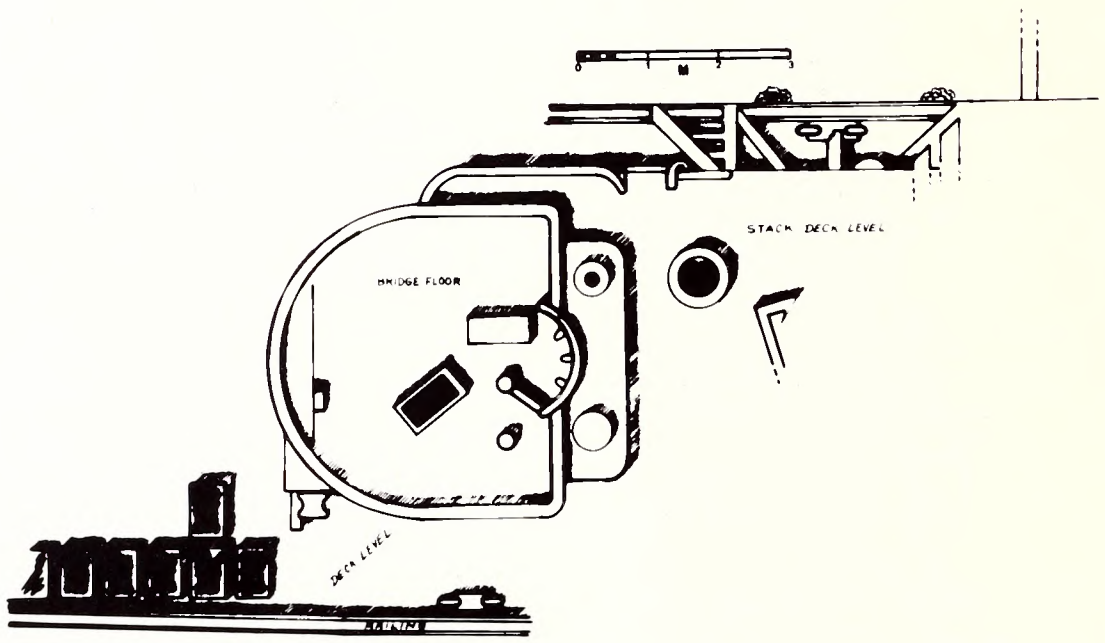

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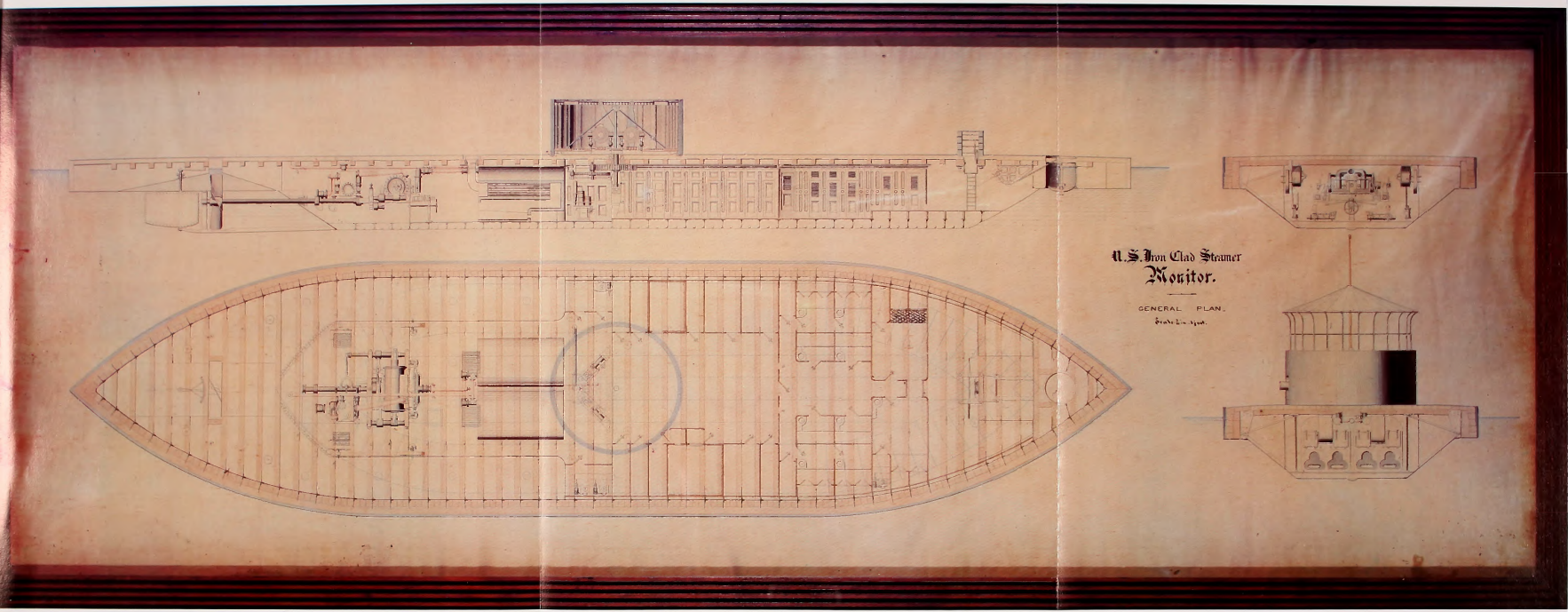


Figure 34. A general plan of the Monitor done in color on tracing cloth and preserved in the collections of the Franklin Institute in Philadelphia, Pennsylvania.

examined with the photographic and television equipment. While the accuracy of this method was relative to the reliability of the historical sources and the accuracy of the system of recording and measurement, correlations between archival documents and the actual remains proved to be sufficient to identify the wreck positively as that of the *Monitor (Figure 36).*

Figure 35. The hard chine separating the flat bottom and sides of the Monitor's lower displacement hull.

Figure 36. Inside the port armor belt (lower left corner), deteriorated coal bunkers revealed an open coal scuttle.

Detailed analysis of the television tape and photographic data confirmed that the vessel rolled over upon sinking and is now lying upside down with the port quarter resting on the bottom of the displaced turret. Because of the excessive physical damage to portions of the hull and armor platform and the random and frequently erratic patterns of the camera passes, several months of analysis were required to isolate and identify the wreck's distinguishing characteristics *(Figure 17)*.

An opportunity to further investigate the remains of the *Monitor* occurred during the first week of April, 1974. The United States Navy, interested in evaluating the sophisticated search and inspection capabilities of the R/V *Alcoa Seaprobe (Figure 37)*, agreed to conduct an examination of the wreck along with several other sites identified by Naval Academy midshipmen during their Project "Cheesebox." At the site *Seaprobe* cruise objectives included photographic documentation and, if possible, recovery of samples from the site for testing and analysis. Additional funding and support for the project was provided by the National Graphic Society, the Massachusetts Institute of Technology, the North Carolina Division of Archives and History, and Duke University.

The R/V *Alcoa Seaprobe* was especially suited for the proposed investigation. Constructed specifically for deep water search and recovery operations, the *Seaprobe* was equipped with computer-controlled cycloidal propellers at the bow and stern that gave the vessel a virtually unrestricted dynamic positioning capability *(Figure 38)*. Search and recovery operations were carried out via an instrument "pod" that could be equipped with a variety of acoustic, closed circuit television, photographic, and recovery equipment. Attached by 4-inch drill pipe, the "pod" was deployed through a centerwell in the hull by an oil-rig-type derrick located amidships *(Figure 39)*.

While deteriorating weather prevented recovery of material from the *Monitor*, closed circuit television permitted a detailed inspection of the wreck. During that inspection more than 1,200 high-quality 35 mm. photographs and several hours of videotape records were produced. Selected photographs from the *Alcoa Seaprobe* investigation were utilized by the Naval Intelligence Support Center to construct a photomosaic of the entire wreck *(Figure 18)*. In addition to confirming identification of the wreck as that of the *Monitor*, data from the *Alcoa Seaprobe* investigation permitted the first opportunity to assess the condition of the entire vessel.

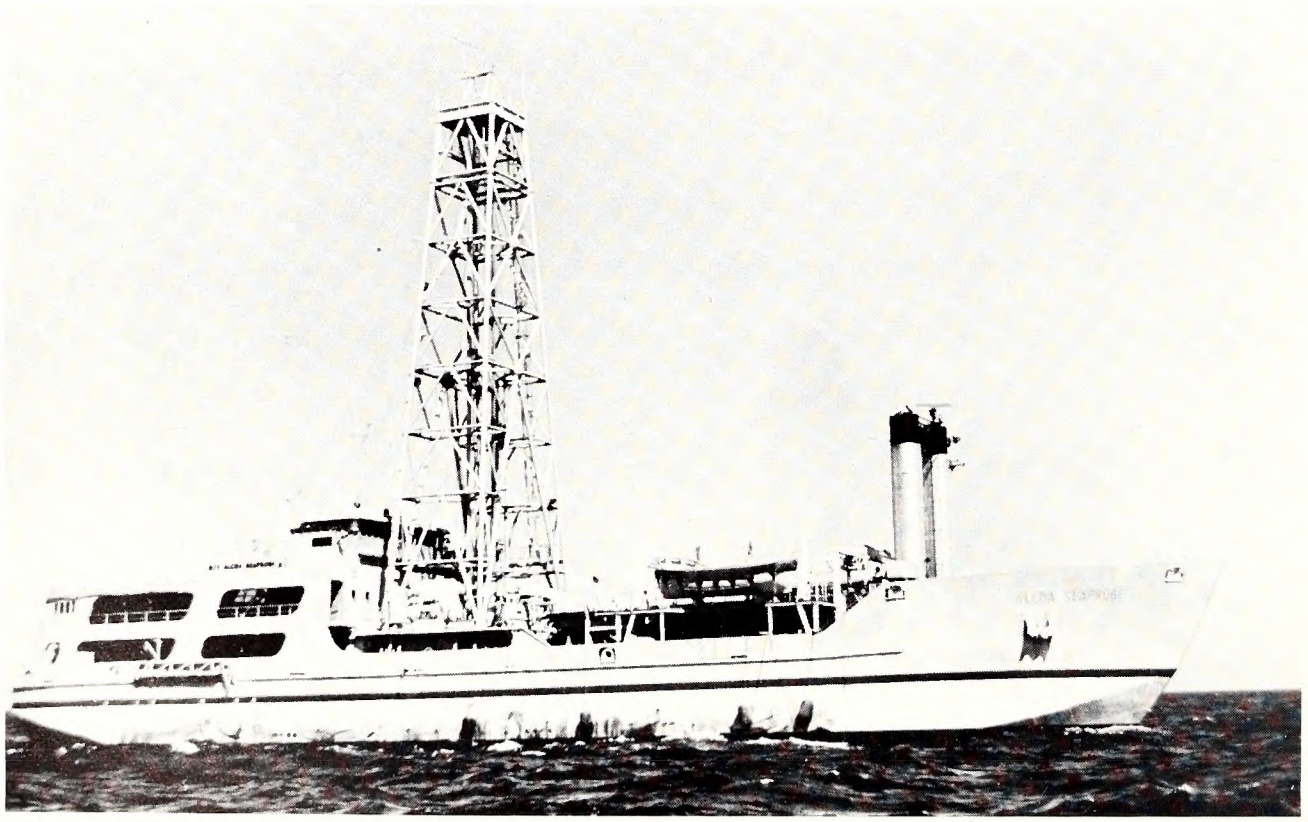


Figure 37. Designed for deep-water search and recovery operations, the Alcoa Seaprobe provided excellent operational capabilities for confirming identification of the remains of the Monitor.

*Figure 38. **Seaprobe**'s search control center provided an indication of the sophisticated computer-controlled dynamic positioning that permitted scientists to conduct a systematic but remote exploration of the wreckage.*

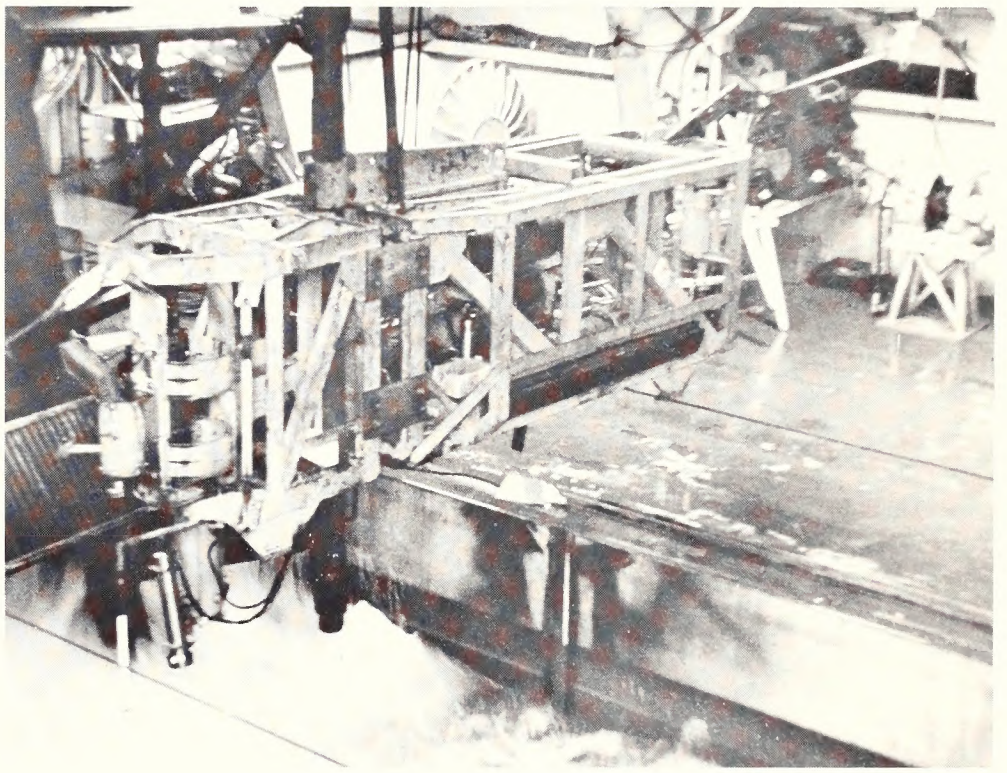


Figure 39. Lowered through a center well in the hull on a four-inch rigid drill "string," a search pod could be carefully positioned to examine and sample shipwrecks using a variety of photographic, television, acoustic, and mechanical equipment.

Returning from a geophysical survey off the Delaware coast, the R/V *Eastward* carried out a series of dredging operations in the immediate vicinity of the *Monitor* in May, 1974. The operation, cosponsored by Duke University and the University of Delaware, was designed to recover artifacts associated with the wreck. While no systematic analysis of the recovered material has been made, the collection included an iron fitting identified as a decklight cover *(Figure 40)* and numerous smaller ferrous concretions.

From August 12 to 16, 1974, the United States Coast Guard and Massachusetts Institute of Technology cooperated to test a remote-controlled search and investigation pod from the *Chilula* at several sites off Cape Hatteras including the *Monitor*. The pod, designated "Snoopy" *(Figure 41)* and equipped with sonar, closed circuit television, and 35 mm. cameras, was to be utilized to recover material from the site. Heavy seas complicated operation of the system, and no contact with the *Monitor* was confirmed.

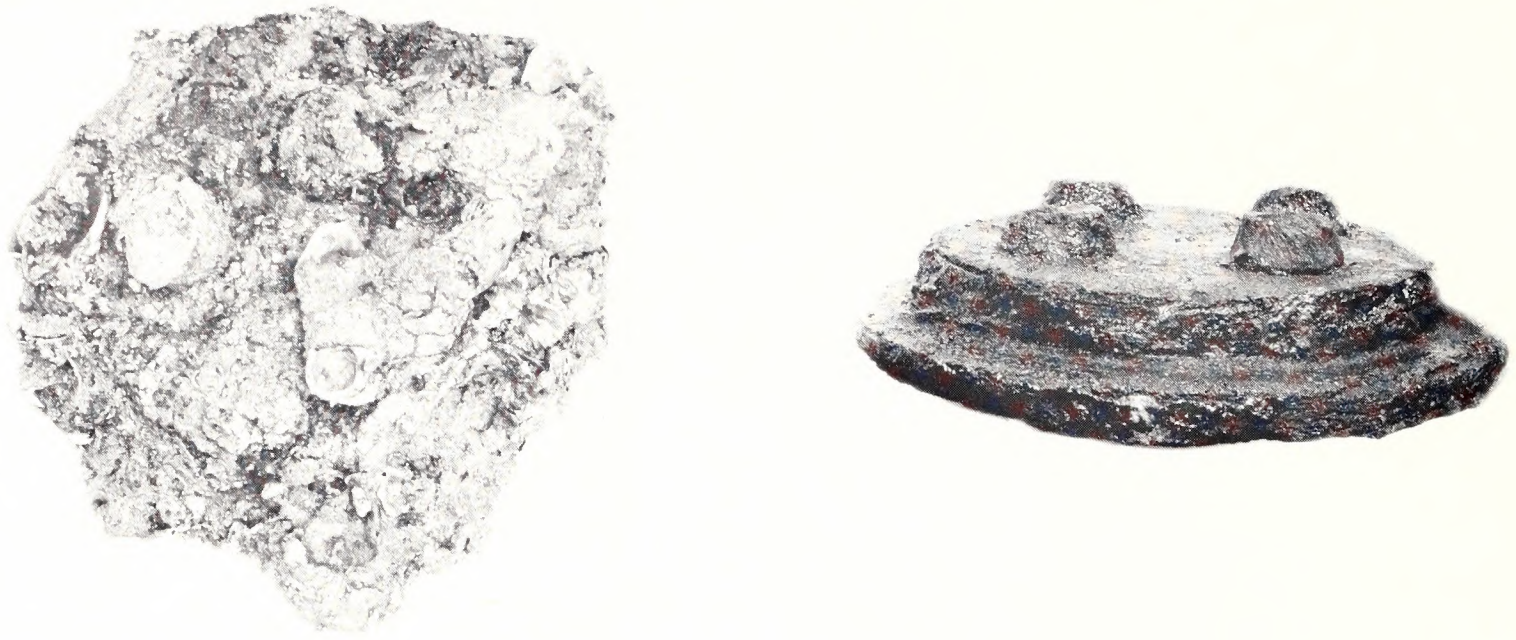


Figure 40. One of a number of artifacts dredged from the vicinity of the **Monitor** *by the R/V* **Eastward** *in 1974 and identified as the remains of a decklight cover.*

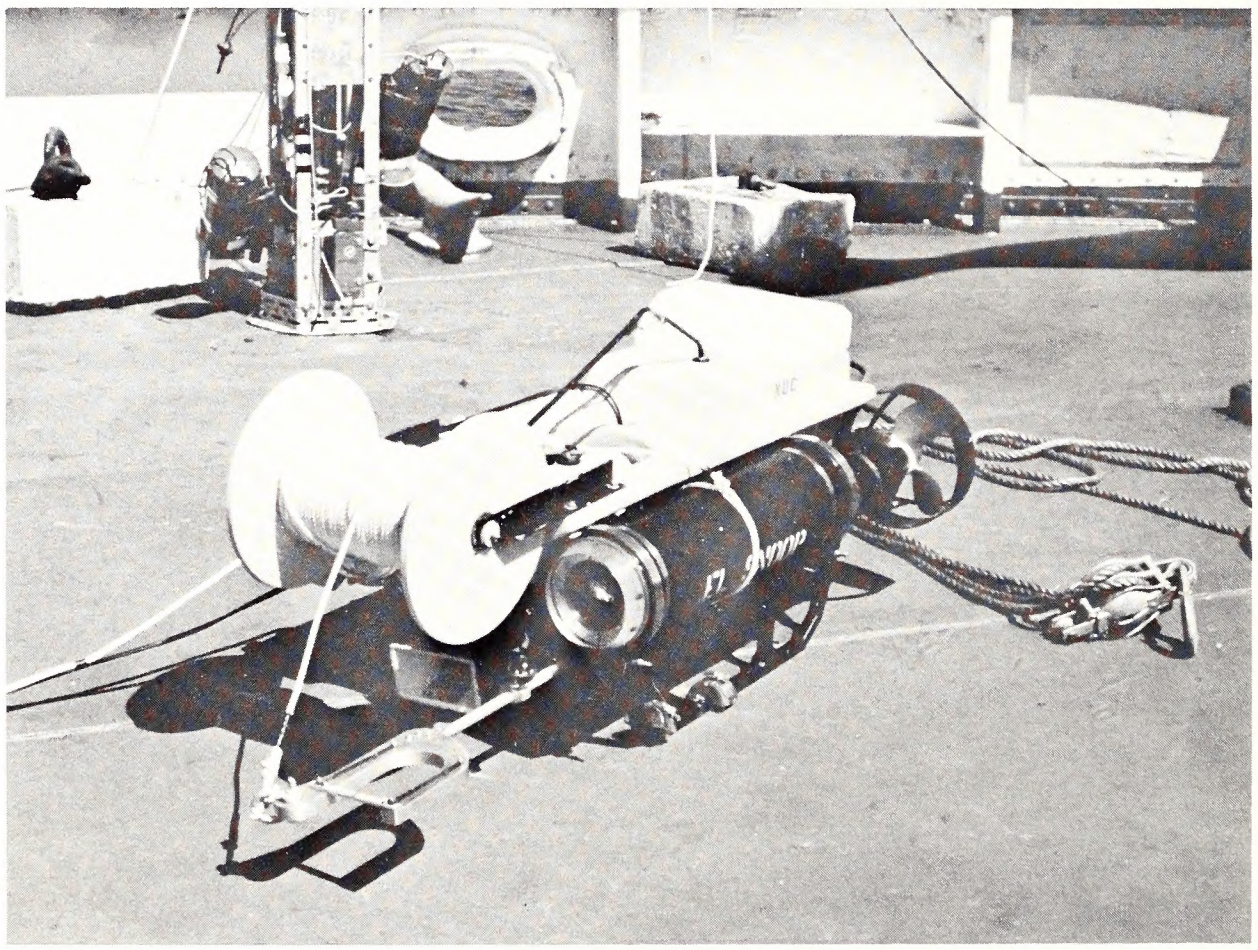


Figure 41. Containing sonar, closed-circuit television, and 35 mm. photographic capabilities, "Snoopy" was designed to operate on a tether from the surface support platform.

Following the unsuccessful *Chilula* investigation, Duke University and Massachusetts Institute of Technology cooperated in a continuation of the "Snoopy" project between August 22 and 26, 1974. Again the objective was to test the system by photographing the *Monitor* and recovering material from the site. Because of restrictions on research at the site following its nomination to the National Register of Historic Places, the project was abandoned.

With funding provided by the National Science Foundation, the University of Delaware and the *Monitor* Research and Recovery Foundation carried out a two-day investigation in the *Monitor* National Marine Sanctuary on June 9 and 10, 1976. Using a proton precession magnetometer, investigators collected data to establish the *Monitor*'s effect on the surrounding regional magnetic field during eight crossings of the wreck. At the same time a subbottom profiler was employed to establish the general direction of the slope of subbottom reflectors in the area and the location of the wreck relative to these reflectors.

Between April 4 and April 8, 1977, the *Monitor* Research and Recovery Foundation and the University of Delaware carried out a project to collect environmental data near the *Monitor* National Marine Sanctuary and examine the wreck with closed circuit television. Support from the Exxon Education Foundation permitted a Braincon current meter to be deployed just outside the sanctuary to record near-bottom currents. Southeast of the *Monitor*, a piston core was used to recover an 18-foot sample of sediment *(Figure 14)*. Closed circuit television permitted horizontal examination of some portions of the wreck forward of the amidships bulkhead *(Figure 42)*.

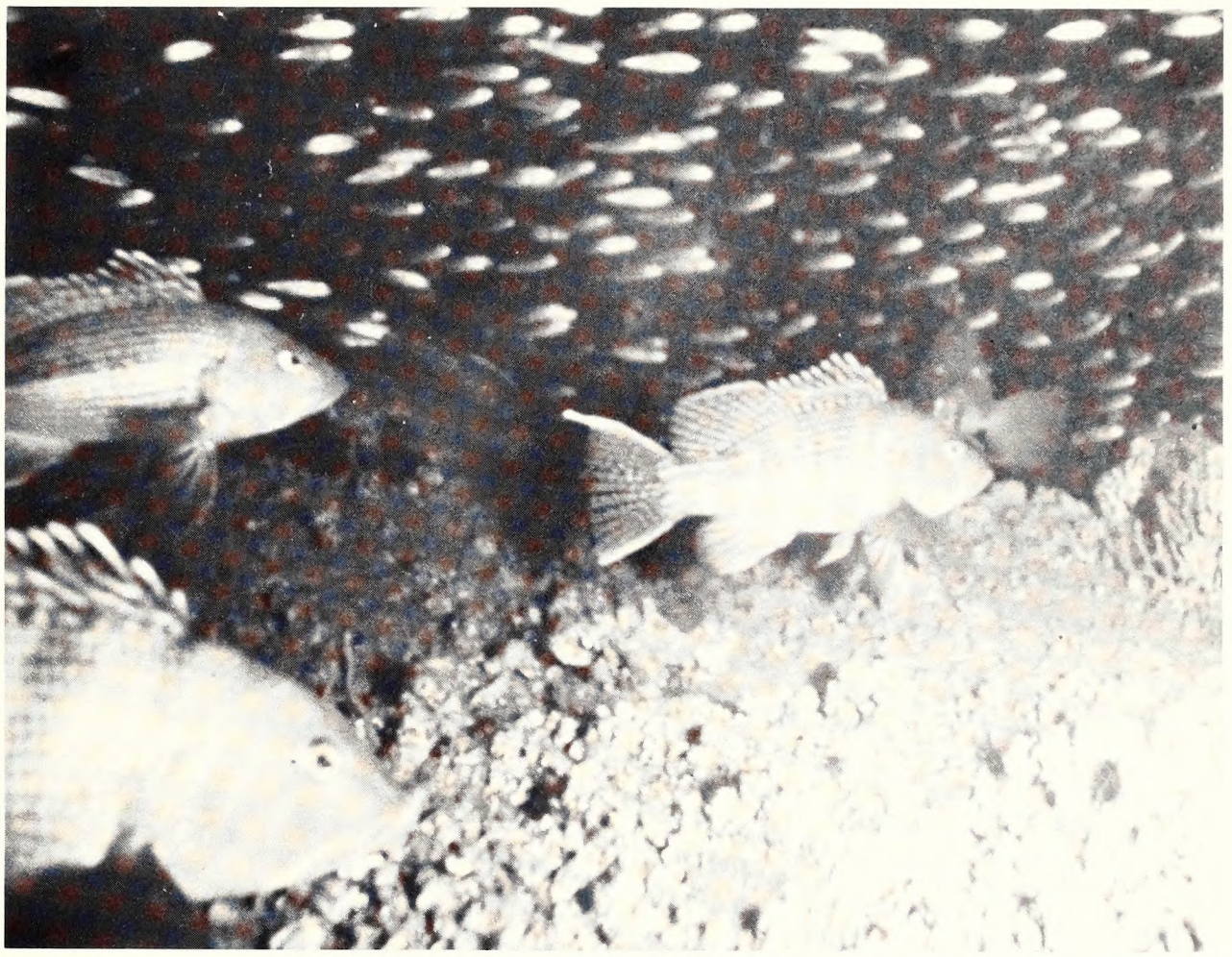


Figure 42. The first horizontal photograph of the **Monitor** *taken forward of the amidships bulkhead revealed the extent and nature of fouling at the site.*

The most extensive and complex research previously undertaken in the *Monitor* National Marine Sanctuary occurred between July 17 and August 2, 1977, when NOAA, Harbor Branch Foundation, and the North Carolina Division of Archives and History cooperated to conduct a photogrammetric survey of the wreck and recover selected material for testing and analysis. The project provided the first opportunity to investigate the wreck using submersibles and lockout divers and greatly enhanced previous knowledge about the condition of the vessel.

Following a side scan sonar examination of the bottom inside the sanctuary *(Figure 30)*, a Cabled Observation and Rescue Device (CORD), a remote-controlled vehicle, was utilized to conduct a closed circuit television examination of the wreck *(Figure 43)*. With the site and potential hazards identified, on-site manned submersible operations began on July 25, 1977. Following a series of dives to examine the wreck and familiarize submersible pilots, divers were locked out along the port armor belt to deploy a baseline designed to control submersible passes during photogrammetric survey operations. After the baseline had been deployed approximately 10 feet north of and roughly parallel to the port armor belt, three sets of photographic passes were made diagonally across the wreck. On two of the operations, black and white film was used while the third series of photographs was made in color.

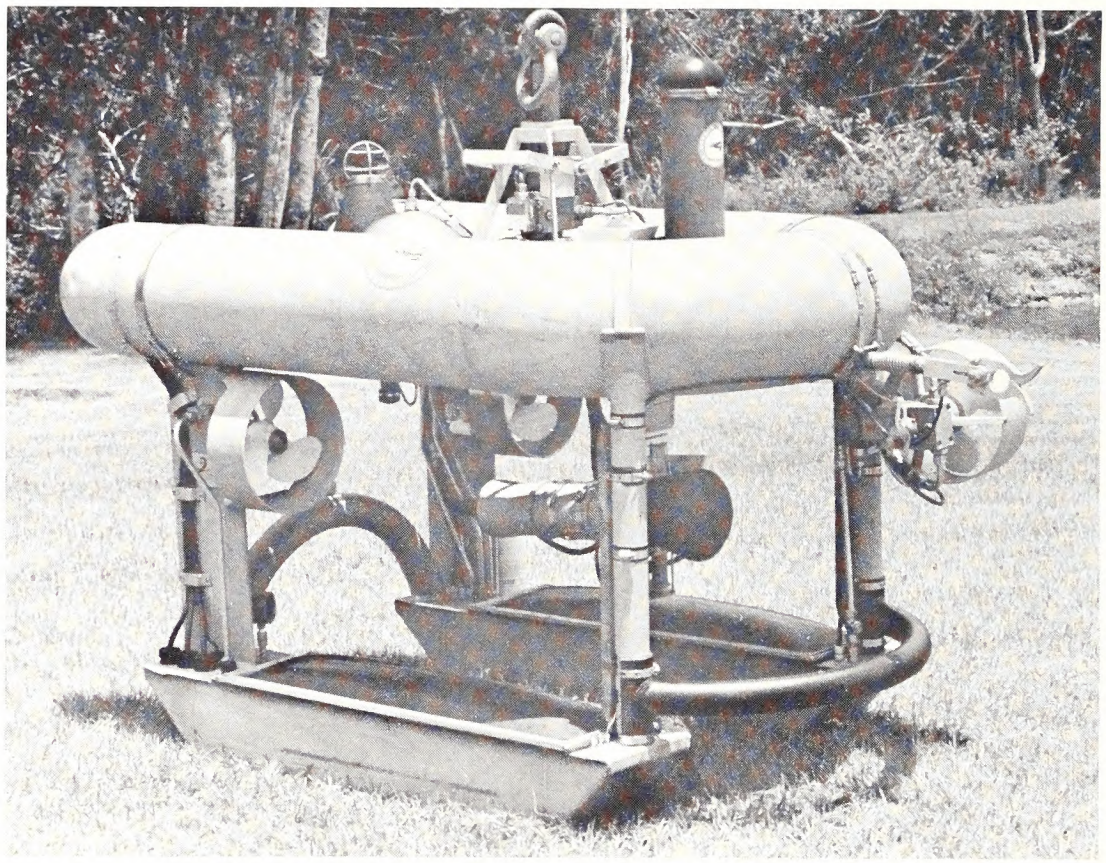


Figure 43. Cabled Observation and Recovery Device (CORD) was developed by Harbor Branch Foundation and employed to conduct a survey of the Monitor's remains prior to manned submersible operations at the site.

Once the stereo photography had been completed, divers were locked out to recover the remains of an oceanographic camera lost during the original R/V *Eastward* investigations, a sample of plate from the lower hull, and a brass signal lantern identified on the first manned submersible operation *(Figures 44 and 45)*. Preservation of the lantern and testing, analysis, and preservation of the sample hull plate provided the first hard evidence of the physical condition of the remains of the *Monitor* and the complex nature of preservation problems associated with the recovery of additional material from the site *(Figure 46)*. Photographic records and visual observations made from the *Johnson-Sea-Link I* and *Johnson-Sea-Link II* submersibles provided insight into the nature and conditions of the wreck that was not possible with previously employed remote observation equipment and set the stage for more extensive research.

Between June 9 and 10, 1979, the Cousteau Society, Inc., supported and carried out a limited filming project in the *Monitor* National Marine Sanctuary. Operating from the R/V *Calypso* and working in groups of up to eight, divers using compressed air made four visits to the site. The first of these was a reconnaissance dive. During the second dive, approximately 12 minutes of film were exposed. The second attempt to film was unsuccessful because of currents that prevented divers from locating the wreck, and the fourth dive was made to clear the area of buoys deployed to support the operation.

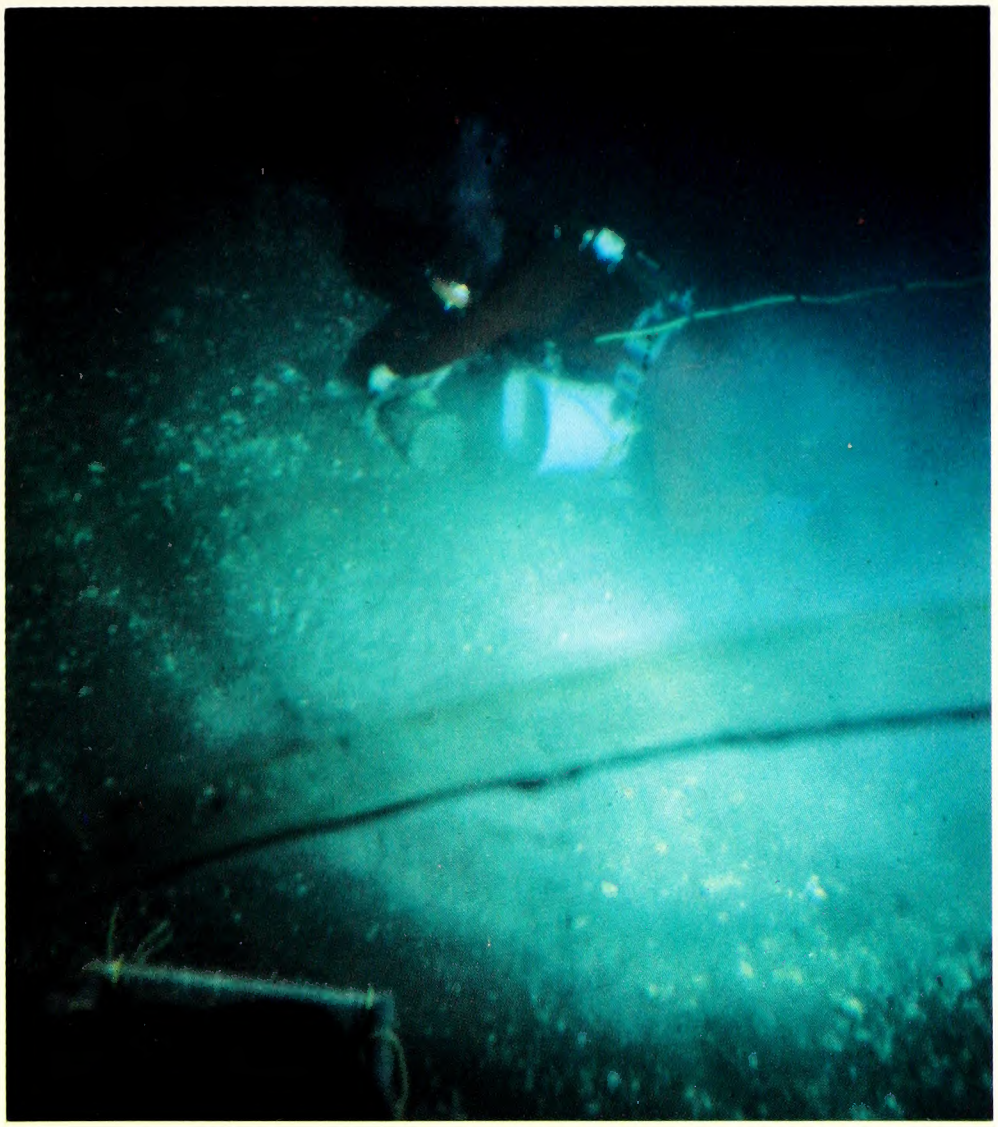


Figure 44. Diver Richard Roesch of Harbor Branch Foundation gently fans sediment away from a brass marine lantern located 40 feet north of the turret on the initial submersible operation in the **Monitor** *Marine Sanctuary in August 1977.*

Figure 45. The brass marine lantern.

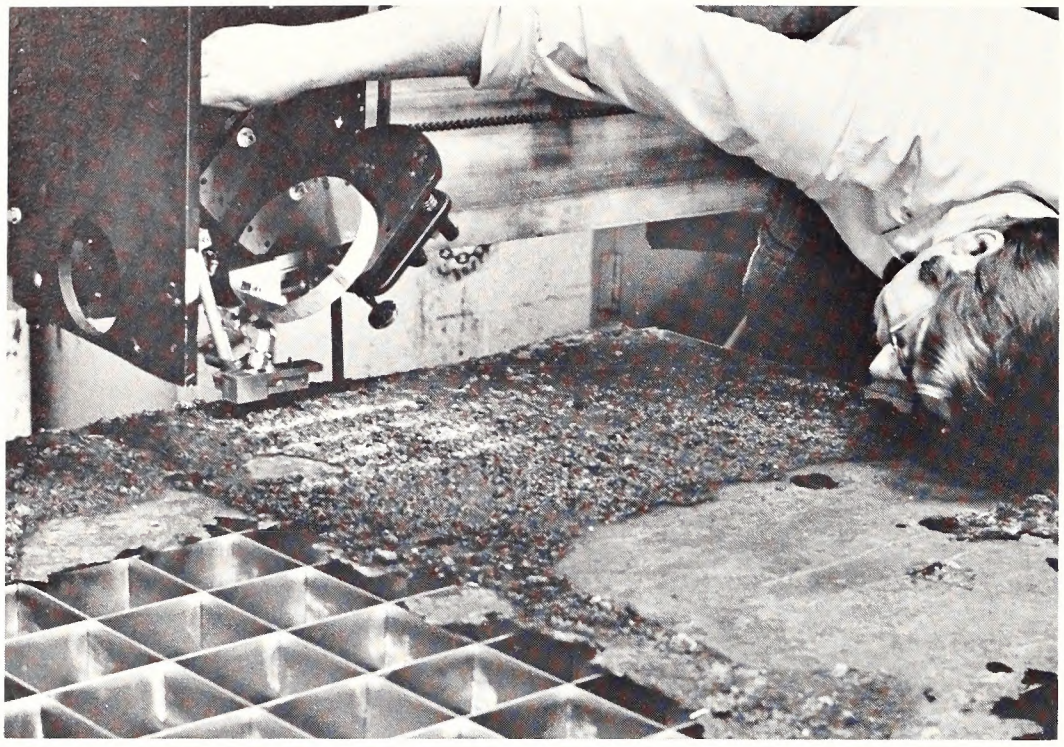


Figure 46. Test samples from the Monitor's *hull plate were removed by laser at United Technologies Research in East Hartford, Connecticut, to avoid problems associated with less sophisticated methods of cutting.*

RESEARCH OBJECTIVES

On-site project activities were designed to accomplish five major objectives: the establishment of a series of permanent provenance stations, a limited test excavation, photographic and video tape documentation of vessel remains at the site, attitude analysis, and a limited amount of structural testing. Secondary objectives included the recovery of samples to facilitate defining conservation requirements for materials recovered from the site, expanded photographic and video tape documentation, and the installation of additional provenance stations. Each of these objectives was designed to generate archaeological, conservation, and engineering data essential to the development of responsible management policies for the *Monitor* Marine Sanctuary and all were identified during the preparation of the "*Monitor* Marine Sanctuary Research and Development Concept."

Perhaps the most critical priority for continued investigation at the site was the establishment of a permanent system of references to control on-site data collection *(Figure 47)*. To provide the desired control a master reference system composed of ten permanent provenance stations was designed to encompass the major concentration of hull remains with a 200 x 68-foot rectangle. Located outside the confines of the hull, the reference stations could provide accurate and accessible dimensional reference both inside the wreck and anywhere in the immediate environment. Should the *Monitor* be raised, the reference system would be available to control postrecovery data collection at the site. At the initiation of on-site work, the nucleus of this baseline system, composed of four noncorrosive 3-inch diameter, 10-foot sections of schedule 80 polyvinyl chloride (PVC) pipe, was to be jetted into the sediment along the north side of the wreck adjacent to the armor belt.

A 5-foot-by-5-foot excavation was planned to test a limited area within the confines of the hull. The resulting data would answer specific questions concerning the nature and extent of the archaeological record preserved at the site, evaluate acceptable methods and techniques that could be employed in the recovery of that record, and recover *in situ* artifacts for analysis and conservation. An area immediately aft of the pilot house and inboard of the port armor belt was selected for the excavation *(Figure 48)*. Photographic data indicated that excavation in this area was not likely to be frustrated by the presence of structural iron from the collapsed lower hull and the test could be systematically carried to deck timber.

Hand-held and submersible-mounted photographic videotape records of the site were planned in order to develop more comprehensive engineering evaluations of the condition of the wreck, answer historical questions about the vessel's design and construction, and aid in assessing conservation problems

associated with recovery of extensive amounts of material from the site. Submersible-mounted cameras were used to document the general configuration of the wreckage and hand-held cameras employed to record specific evidence of damage and deterioration both inside and under the wreck. Particular attention was devoted to areas of the structure that had not previously been thoroughly examined.

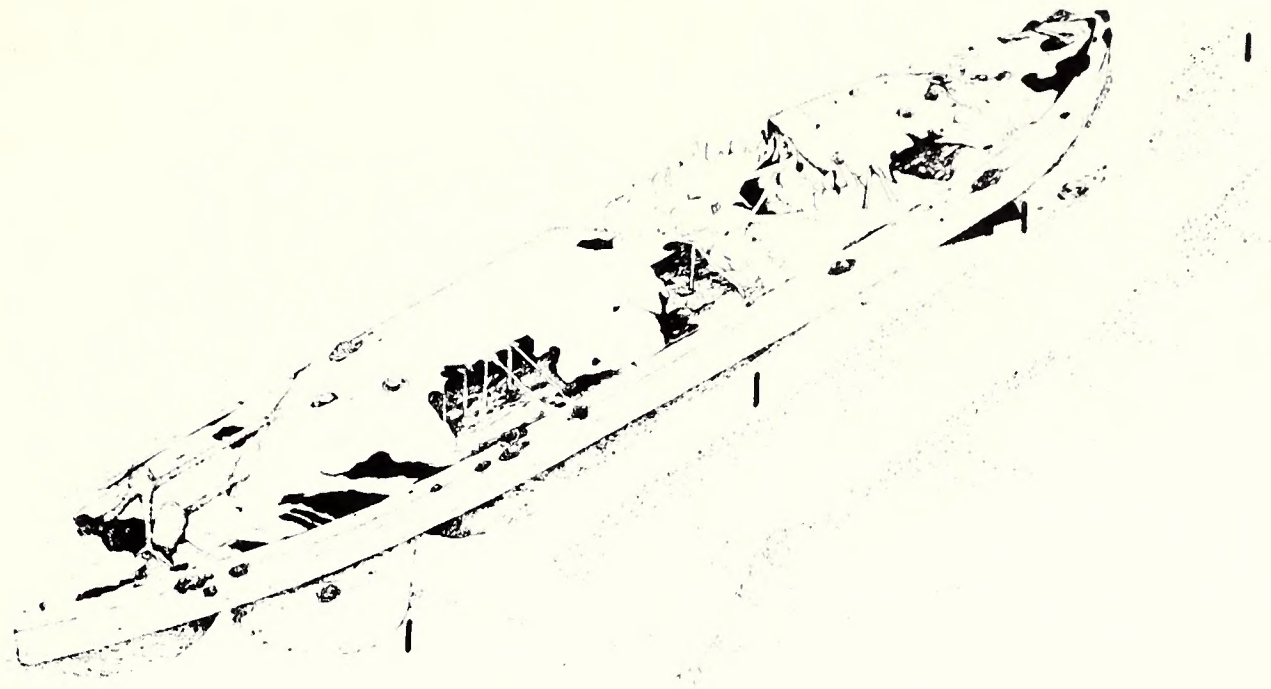


Figure 47. Baseline casing locations.

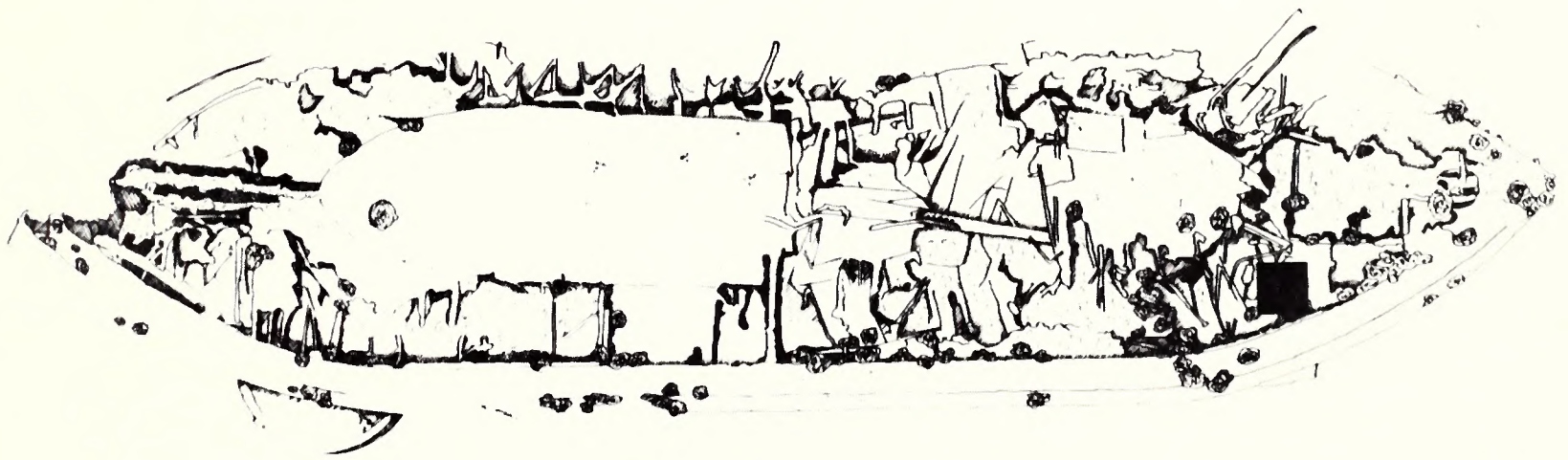


Figure 48. Test excavation location.

At preselected locations along the armor belt and lower hull, measurements were made to determine the degree of list and pitch of the hull remains *(Figure 49)*. These measurements were analyzed to determine the degree of stress-related distortion and to calculate the amount of accumulated sediment inside the confines of the hull. An inclinometer specifically designed for the project was employed to produce the desired data.

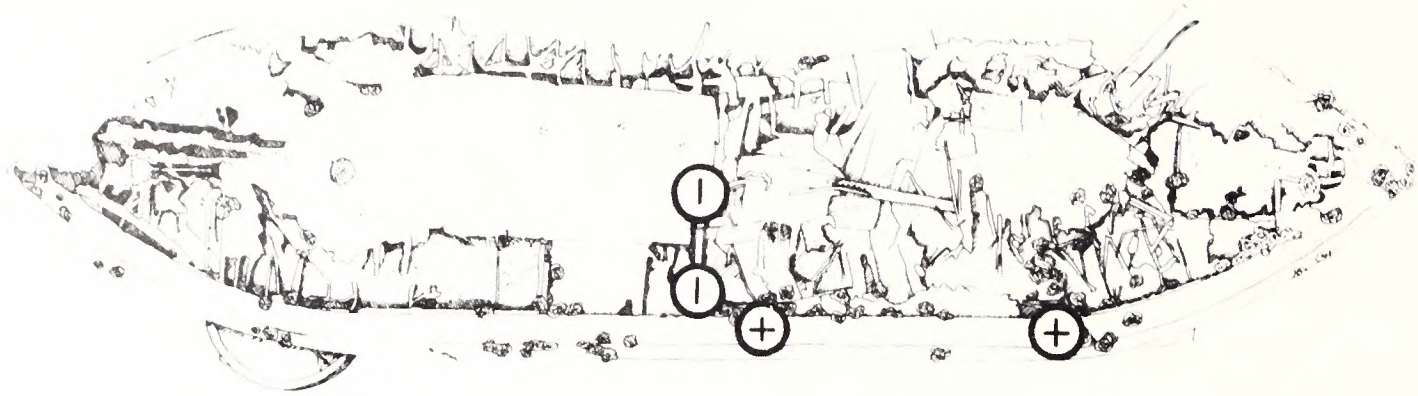


Figure 49. Inclinometer test locations and orientations.

Where the excavation exposed deck beams and decking, small samples of structural wood were to be recovered for analysis and testing. Additional samples were to be taken along the armor belt where deterioration of the iron armor permitted. Samples, to be used in determining the present condition of the wreck, were to be replaced with a noncorrosive neutral material to prevent additional damage to the structure.

Secondary objectives for the project included the installation of additional provenance stations, expanded photographic and videotape documentation, and the recovery of artifact and structural samples. Both the additional documentation and the collection of samples and material from the wreck were designed to generate data useful in answering engineering and conservation questions about the wreck. Each of the proposed secondary objectives was designed to provide flexibility and acceptable alternatives when on-site activities could not be directed toward primary project objectives.

DESCRIPTION OF DELIVERY AND LIFE SUPPORT SYSTEMS

On-site project operations were carried out from the Research Vessel *Johnson (Figure 50)* provided by Harbor Branch Foundation. The R/V *Johnson*, originally constructed as a 125-foot Coast Guard cutter, was redesigned and fitted out to serve as a submersible support vessel for the *Johnson-Sea-Link I*, a submersible lockout system capable of operating to 1,500 feet. In addition to providing a stable platform for launch and recovery of the submersible, the vessel contained a transfer-under-pressure decompression facility, scientific laboratory, machine and electronics shop, and facilities designed to support a total of twenty-two persons.

The delivery system for archaeologists and divers involved in the conduct of on-site operations was the four-man research submersible *Johnson-Sea-Link I (Figure 51)* carried aboard the R/V *Johnson*. Inside the two manned pressure hulls of the *Johnson-Sea-Link I*, scientists could operate to maximum depths of 3,000 feet and lockout personnel from the after compartment at depths as great as 1,500 feet. The forward pressure sphere was constructed from a 4-inch thick acrylic sphere 58 inches in diameter and provided virtually unlimited visibility at normal atmospheric pressure. The submersible pilot and observer riding in the sphere operated the vessel and controlled diver decompression.

An 8-foot long, 52-inch diameter compartment composed of welded aluminum located immediately aft of the acrylic plexiglass sphere had been designed to provide sufficient space for two additional observers or a diver/scientist and diver tender. Two side viewing ports provided visibility and a medical lock had been installed to facilitate treatment in the event of an emergency. In addition to controls for diver breathing gas, the chamber was fitted with extensive emergency equipment and supplies. Breathing equipment consisted

of umbilical-supplied open circuit KMB-10 helmets equipped for communications and an 18-cubic-foot emergency bail-out bottle. Operational efficiency, reliability, and safety were additionally enhanced by underwater communications, an FM transceiver for submersible to surface communication, intercom, Doppler navigation system, obstacle avoidance sonar, echo sounder, closed circuit television, and a mechanical arm. Eight thrusters had been installed to provide three-dimensional mobility. Power for the submersible's systems came from an oil-compensated battery located in a pod beneath the acrylic sphere.

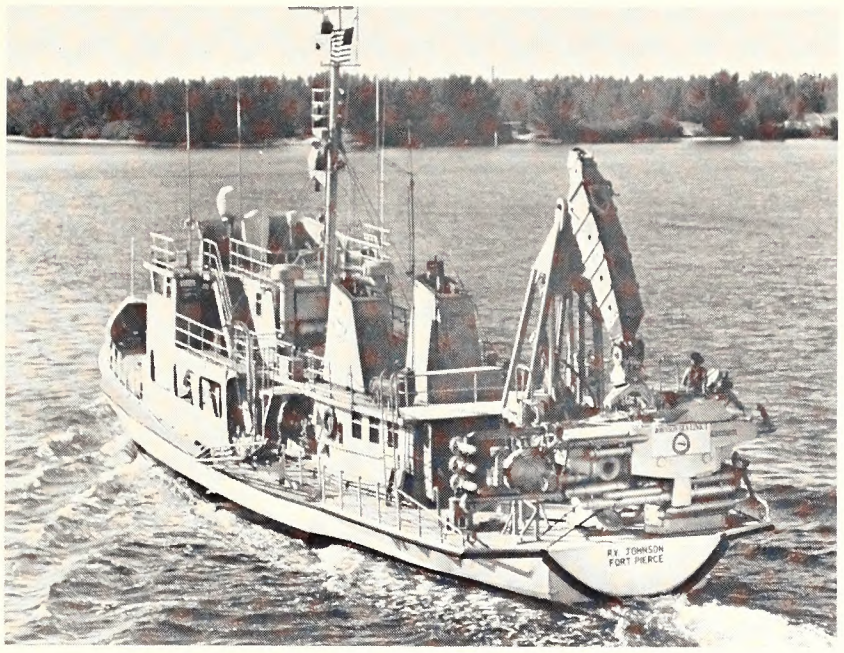


Figure 50. Surface support vessel R/V ***Johnson.***

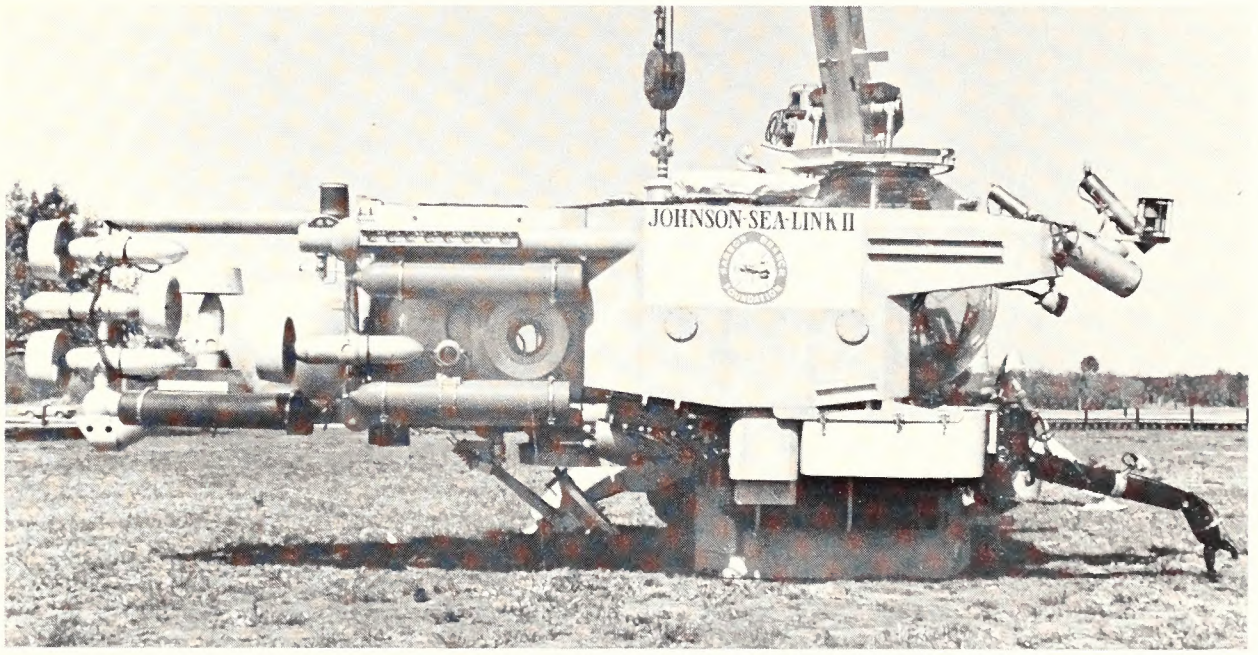


Figure 51. Four-man research submersible ***Johnson-Sea-Link I.***

DESCRIPTION OF EQUIPMENT

Conduct of the proposed on-site work required the design and construction of additional scientific and support equipment. Several criteria were paramount in developing equipment to accomplish project objectives. First, it was imperative that all equipment used on-site be suitable for transportation to and from the site by submersible. Tools and equipment requiring power had to be designed to operate from the submersible. As only one scientist/diver was permitted to operate in the lockout mode at a time, all of the equipment had to be designed for operation by one person.

Two operations required submersible power. The first called for jetting or washing a series of casings into the bottom sediment to form the nucleus of a baseline. The second, removal of sand from the test

excavation, required power for a small dredge. To satisfy both requirements a 2-horsepower, 24-volt submersible electric motor similar to the submersible's thrusters was mounted forward of the pilot's sphere. This was used to drive a 175-gallon-per-minute centrifugal pump *(Figure 52)*. Sea water drawn through the pump's 2-inch intake was discharged through 1-inch internal diameter pressure hose, which could be connected to both a water jet and an entrainment dredge. Operation of the pump was controlled from the submersible sphere in response to verbal communications from the scientist/diver. The water jet was constructed from a 10-foot section of 3/4-inch interior diameter PVC tubing. A 90-degree elbow was attached to one end so that the connecting pressure hose would be less likely to kink. The elbow also served to position the jet correctly inside the casings as they were washed into the sediment. A short lanyard attached to the elbow was utilized to compensate for back pressure on the jet.

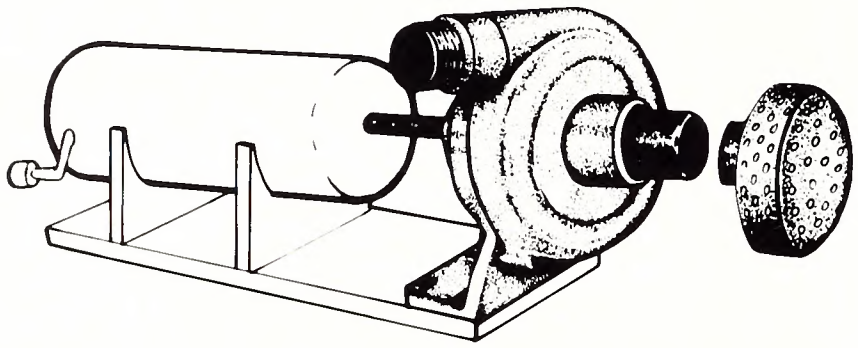


Figure 52. Centrifugal pump.

Datum casings used to establish the nucleus of an on-site grid system were made from 10-foot long sections of 3-inch schedule 80 PVC tubing. PVC was selected because of its light weight, strength, and resistance to corrosion and deterioration. Once installed vertically in the sediment, the casings were designed to serve as references for photography, mapping, excavation, and positioning.

To ensure that the casings were installed with a high degree of vertical accuracy, a leveling collar was constructed *(Figure 53)*. The collar consisted of a 12-inch long aluminum tube 1/32-inch larger in internal diameter than the 3-inch PVC casing sections and fitted with a 6-inch base ring containing two bubble levels positioned to function at 90-degree angles. Originally the leveling collar was designed to be secured by thumb screws, but sediment flushed into suspension during jetting collected between the collar and casing, making removal or adjustment impossible. To eliminate the problem, the collar was split and altered to be secured with shock cord.

To facilitate removal of sediment in the test excavation, an entrainment dredge *(Figure 54)* was assembled to operate on water provided by the 175-gallon-per-minute pump mounted on the submersible. The dredge was composed of a 1½-inch diameter flexible reinforced suction hose. At the discharge end of the suction hose, a 2½-inch-by-20-inch power jet nozzle was installed. Water from the submersible's pump was injected into the jet nozzle that, as a venturi eductor, created sufficient suction to transport water and suspended sediment away from the excavation. Operating at capacity, the dredge was calculated to carry away approximately one cubic yard of sediment per hour. To maintain water clarity in the excavation area and limit the length of pressure hose required, the discharge end of the dredge was placed outside the hull remains of the *Monitor* and down current from the excavation.

Positioning of the datum casings required a high degree of accuracy. This accuracy was ensured through the use of a harness designed to control the location of each casing during installation. Stainless steel rings constructed to slide snugly over each casing were fitted with a series of loops installed to serve as connectors 3 inches from the casing center. A series of ⅛-inch stainless steel cables was fitted with bronze swivel snaps in lengths of 49 feet 6 inches, 24 feet 6 inches, 9 feet 6 inches, and 4 feet 3 inches to serve as harness segments for positioning each casing in the baseline in relationship to the hull of the *Monitor*.

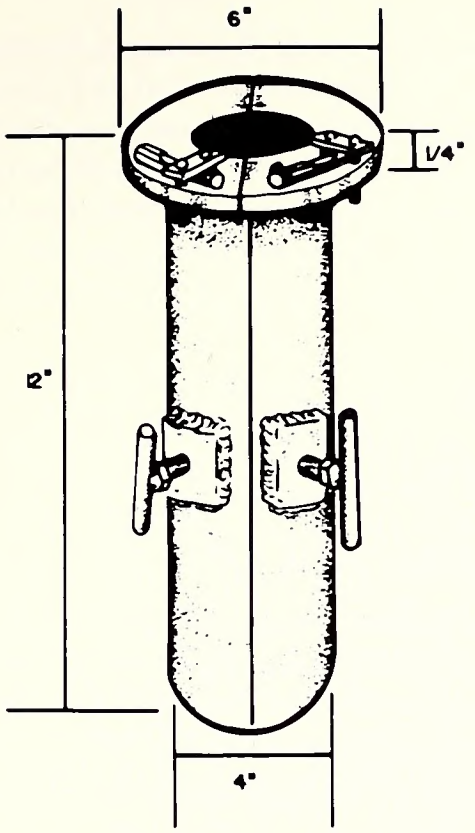


Figure 53. Datum casing level.

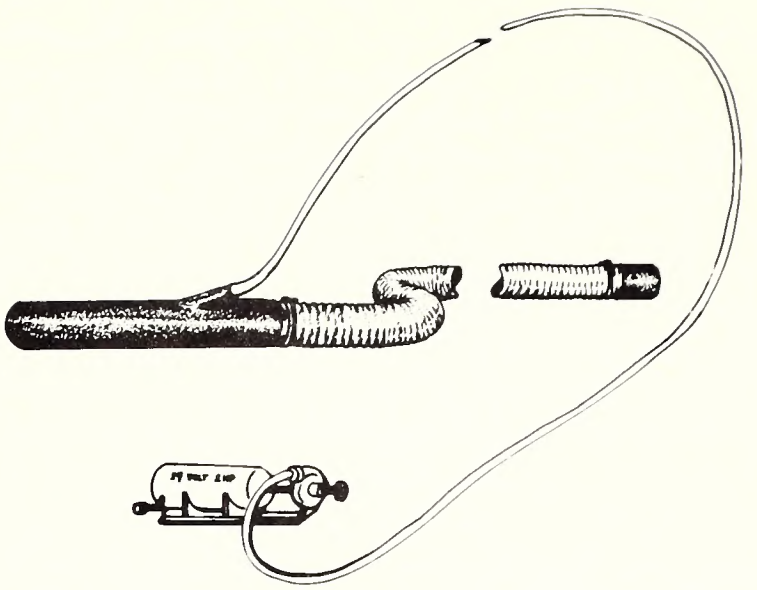


Figure 54. Entrainment dredge.

An aluminum grid frame and camera mount *(Figure 55)* were designed and constructed to control the collection of data and documentation of the test excavation. Aluminum angle ¼-inch thick and 2½ inches by 2½ inches was used to fabricate a frame between four vertical leg sockets positioned on 6-foot centers. Each leg socket was constructed from 2⅛-inch internal diameter aluminum tubes 6 inches in length and fitted with hand-adjustable set screws. The surface of the frame was fitted with a series of perpendicularly oriented bubble levels to facilitate proper horizontal alignment. Three 2-inch-diameter, 4-foot-long legs and a fourth 10-foot-long, 2-inch-diameter leg were constructed with 6-inch spikes to support the grid frame inside the wreck. An articulated arm camera mount, 4 feet in length and 1 inch in diameter, was fabricated to mount a closed circuit television camera on the 10-foot long leg.

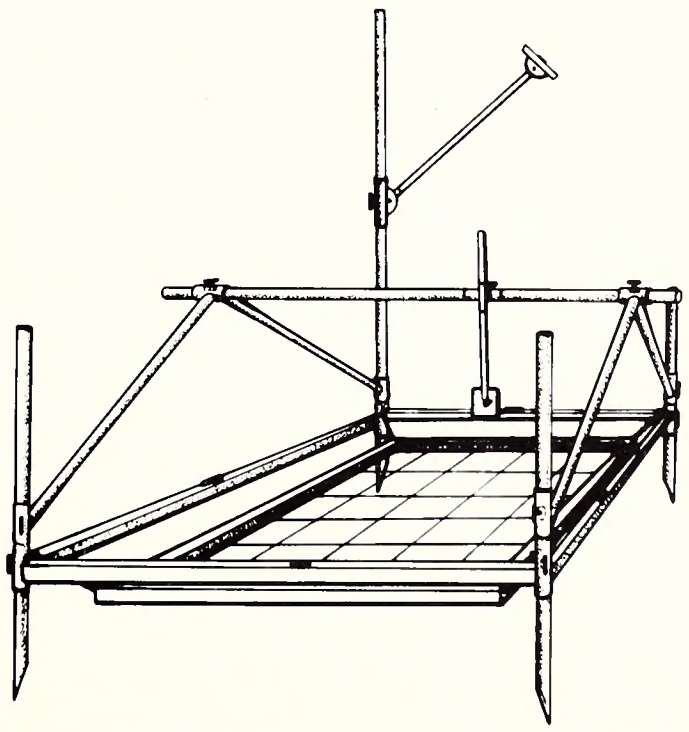


Figure 55. Grid frame.

A 2-inch-diameter, 6-foot 6-inch long camera bar was constructed to mount horizontally above the grid on two "A" frames. Each of the "A" frames was designed to slip over any two of the grid legs. Two 6-inch-long sockets, 2⅛ inches in internal diameter, were fitted to attach to the legs via hand-adjustable set screws. At the apex of each frame a third 6-inch-by-2⅛-inch socket with hand-adjustable set screws was mounted horizontally, perpendicular to the frame, to accept the camera bar. A 10-inch-by-10-inch plate mounted on another 6-inch-by-2⅛ inch internal diameter socket was fitted to mount cameras and strobes. Both camera mounts were designed for infinite lateral adjustment along the horizontal camera bar, and each was fitted with levels to assure precise orientation.

To assist in photo mapping, a 5-foot-by-5-foot photo frame was designed and constructed to lower horizontally into the excavation for a reference. The frame was divided into twenty-five 1-square-foot sections by a series of small high visibility wires. Chains attached to the corners of the photo frames were designed to attach to lugs mounted in the corners of the grid frame. By mounting each corner at a corresponding link in the adjustment chains, the photo frame could be both leveled and centered.

Camera systems for the project consisted of 35 mm. Nikkormatt FT2 and Nikon EL2 camera bodies with Nikon 28 mm. f 3.5, 24 mm. 12.8, 18 mm. 14, and 15 mm. 15.6 lenses. A Sunpak 611 electronic flash was utilized to augment available light. Both the camera and strobe systems were housed in Ikelite plexiglass housings. A Nikonos camera equipped with a 28 mm. 13.5 lens and SubSea 225 strobe were used as backup equipment during on-site operations. Throughout the project Kodak Ektachrome 200 and Plus-X pan films were used for documentation and mapping.

To transfer elevation data from the bow of the *Monitor*, selected as an arbitrary on-site reference, a bubble tube level was fitted with an electronic indicator *(Figure 56)* so that a single individual could carry out the entire operation. One end of the tube was equipped with a housing containing a Delaval magnetic switch, battery, and mounting bracket. Calibrations on the housing were provided to ensure that mounting elevation would conform to the desired arbitrary elevation. Wire run through the clear plastic bubble tube operated an indicator light positioned near the end opposite the switch. With the switch canister mounted at the desired elevation and the tube filled with breathing gas from a special adaptor on the dive helmet, the opposite end of the tube containing the indicator light was placed next to the point at which an elevation was needed. By lowering the arc of the level tube, the bubble was forced into the switch canister, tripping the switch and activating the indicator light. From this known elevation, vertical control could be transferred to the test excavation grid or any other feature on the wreck.

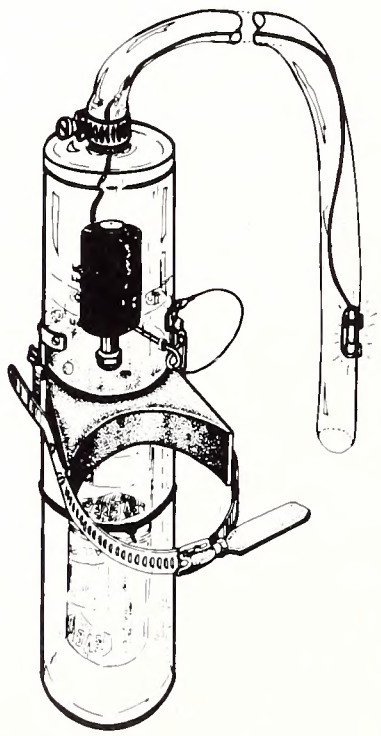


Figure 56. Bubble tube level.

To assure that material recovered during the investigation was properly transported to the surface, an artifact recovery basket was constructed of aluminum *(Figure 57)*. A 30-inch-by-20-inch-by-15-inch frame was covered with expanded aluminum mesh and fitted with a similarly constructed and hinged top. Expanded mesh dividing plates were constructed to partition the basket into two or four equal containers, each capable of holding a variety of plastic storage containers for artifacts. Nylon lift straps attached to the basket were designed to accommodate lift bags used to transport the container to the surface when required.

An inclinometer *(Figure 58)* was designed to establish the approximate degree of list, pitch, and distortion. The instrument was constructed from a 180-degree protractor with a 6-inch radius and graduated to 30-minute accuracy. The protractor was mounted inside a 3-inch-by-6½-inch-by-12-inch case constructed from ½-inch-thick clear plexiglass. A weighted 6-inch pendulum was mounted on a perpendicular sleeve designed to operate on a shaft attached through both the protractor and plexiglass housing. This arrangement was attached to a 3-inch-by-24-inch-by-½-inch plexiglass base fitted with four adjustable legs. Adjustable legs permitted the instrument to be calibrated and made accurate measurements possible in spite of fouling that would have precluded the use of instruments requiring an unobstructed surface. Because the pendulum operated inside an enclosed housing filled with fresh clear water, its action was not affected by current and poor visibility.

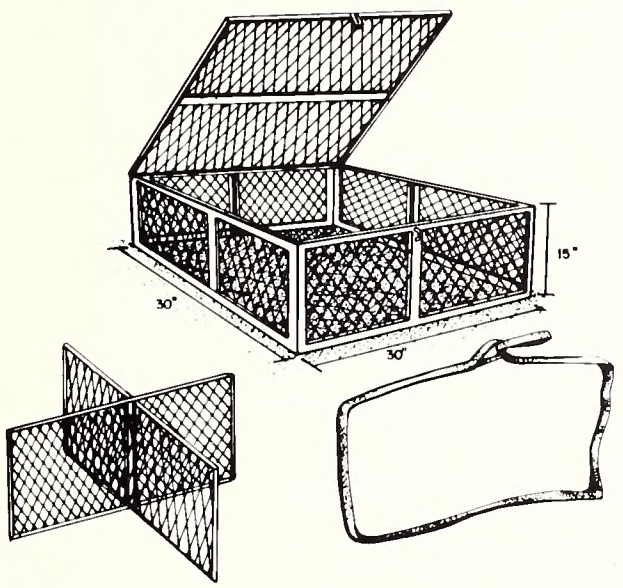


Figure 57. Recovery basket.

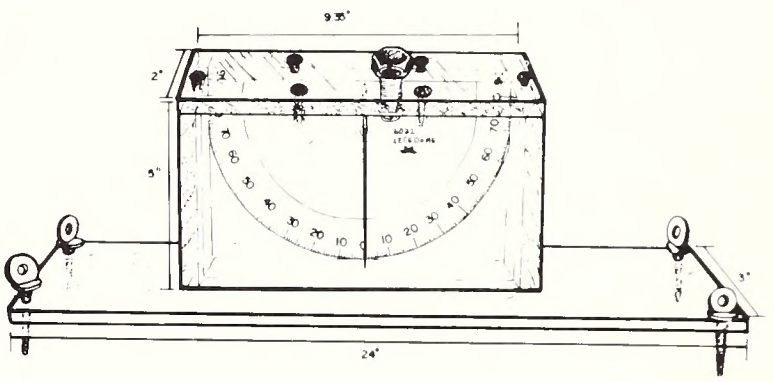


Figure 58. Inclinometer.

DESCRIPTION OF THE WORK

In preparation for the on-site research, archaeologists from the Underwater Archaeology Branch of the North Carolina Division of Archives and History and the Virginia Historic Landmarks Commission underwent an extensive series of physical examinations at the Duke University Hyperbaric Medical Center in Durham, North Carolina, and completed a ten-day training and equipment familiarization program carried out with Harbor Branch at Fort Pierce, Florida and West End, Grand Bahama Island. The training exercise proved to be of tremendous benefit, as it provided the first insight into the nature and limitations of the delivery and support systems that would have to be considered in developing and constructing equipment to be used in on-site operations. In addition, training in the submersible provided the archaeologists with experience that would permit them to concentrate on accomplishing project objectives.

On-site operations began on August 1, 1979, with a nonlockout reconnaissance dive. In addition to examining the site to identify material hazardous to the operation of the submersibles, a thorough examination of the datum station locations north of the wreck was made. At locations adjacent to the turret, slightly aft of the amidships bulkhead, approximately 50 feet forward of the amidships bulkhead, and

adjacent to the bow, depth measurements were recorded to provide an indication of the bottom typography. Although a slight slope from 218.5 feet at the stern to 221 feet at the bow was noted, the gradient was not sufficient to create problems in transferring elevations to datum casings that would be installed at each location.

Once the area had been cleared for submersible and diving operations, installation of the datum casings began *(Figure 59)*. From a position 4 feet north of the approximate center of the exposed arc of the turret, a 4-foot magnesium rod was driven into the sediment to secure one end of the datum casing harness. From this position the 150-foot harness was deployed parallel to the armor belt to a point north of the bow. A second magnesium rod was driven into the sediment 2 feet forward of the bow. From this point a 32-foot section of the harness was deployed north until it could be attached to the free end of the 150-foot section secured at the turret. With both sections taut, the harness identified a preselected location for the datum casings that would assure a baseline paralleling the longitudinal axis of the wreck. At this point a third magnesium rod was installed to secure the harness.

After examining both sections of the harness to assure that neither was fouled, the first datum casing was jetted into the sediment adjacent to the amidships bulkhead. With the casing properly positioned inside the harness ring and oriented vertically according to the leveling collar, a water jet powered by the submersible's pump was used to flush sediment inside the casing into suspension. Unconsolidated, the sand and shell hash offered little resistance to sinking the casing to a depth of 5.5 feet. With water from the pump turned off, sand and shell settled to hold the casing securely in position.

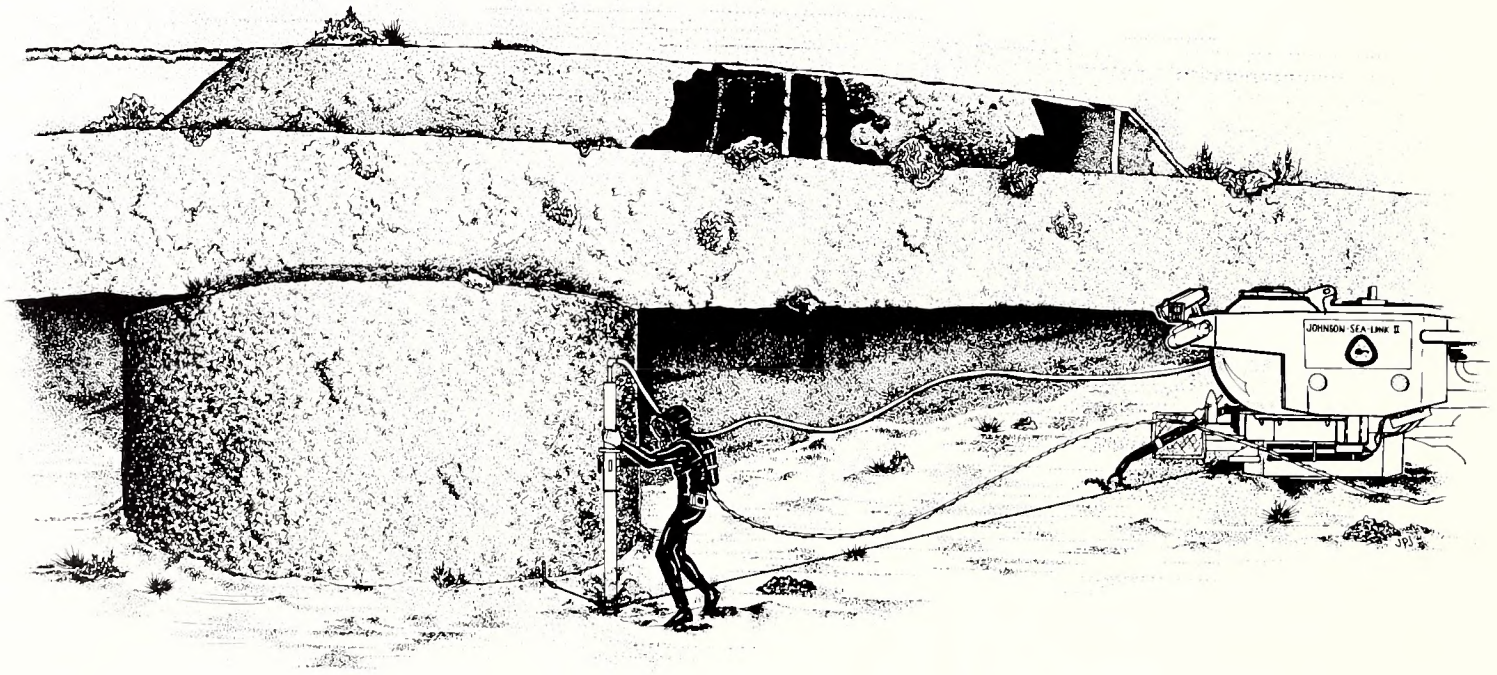


Figure 59. Artist's rendering of installation of datum casings.

While a second casing adjacent to the turret was readily jetted into position to a depth of 5 feet, a layer of concreted shell, possibly formed in association with deteriorating ferrous material from the wreck, frustrated sinking the two remaining casings. Extensive bouncing of the casings to dislodge concreted shell 3 feet below the bottom produced no apparent progress and flushed extensive amounts of ferrous oxide into the water. Although sufficient sediment existed above the layer of concreted shell to hold the forward casings in position temporarily, heavy currents that occurred later in the project created sufficient pressure to dislodge them.

With the datum casing operation underway, an examination of that area of the port bow selected for the test excavation was made to identify the precise location of the excavation and set up the grid frame. As was indicated in photographic records of the wreck, most of the interior of the hull forward of the amidships bulkhead had been covered by the collapsed remains of the lower hull. With the exception of an area inboard of the port armor belt and a second including and immediately aft of the pilot house, structural iron beams and plate precluded site testing activities. After thoroughly examining the forward portions of the wreck, a test site was selected immediately inboard of the port armor belt 35 feet aft of the bow *(Figure 60)*. Although structural iron was present, no evidence to suggest the subsurface presence of heavy plate was apparent.

Figure 60. Test excavation location on mosaic.

Grid frame components transported to the site aboard the submersible were assembled to delineate the test excavation area and provided the desired horizontal and vertical control. With the frame, legs, and camera bar assembled and in position the entire structure was vibrated to set each leg firmly. The vertical orientation of each leg was then reestablished and the grid frame and camera bar leveled. With the 5-foot-by-5-foot photographic frame in position, four stainless steel bone pins were forced into the sediment to define the excavation limits *(Figure 61)*.

Figure 61. Diver with grid frame and camera.

After solving a series of camera case compression and flooding problems, the undisturbed surface of the test excavation area was photographed. Significant features were plotted in three dimensions using underwater tapes. Measurements were all made in reference to the grid frame. Conventional mapping techniques were enhanced by data preserved in the photographic record.

Following erection of the grid frame, closed circuit television videotape records were made of all test excavation activities. At the beginning of each dive the camera was removed from the submersible and mounted on either a tripod or an articulated arm on the grid frame. In addition to preserving a visual record of test excavation activities, the videotape recorded all diver-to-submersible and submersible-to-surface communications. At the end of each lockout, the camera was removed from its mount and returned to the submersible.

Excavation was initiated *(Figure 62)* as soon as an acceptable photographic record of the test site had been obtained, and a bottle embossed "U.S. NAVY" and "MUSTARD" was removed from the sediment surface. Sediment was hand fanned into suspension and carried away by a 2½-inch diameter induction dredge powered by an electric pump on the submersible *(Figure 63)*. Discharge from the dredge was deposited outside the confines of the hull immediately north of the port armor belt, 5 feet aft of the test excavation site. By hand fanning sediment into suspension, coral and shell that clogged the dredge could be separated and removed. This technique provided considerably more control over the excavation and assured that small artifacts and material from the *Monitor* would not be inadvertently lost. With the initial 6 inches of sand, shell hash, and coral cleared away, structural material exposed *in situ* was photographed and plotted *(Figure 64)*.

Figure 62. Once erected on-site, the grid frame controlled excavation and data collection within the test excavation.

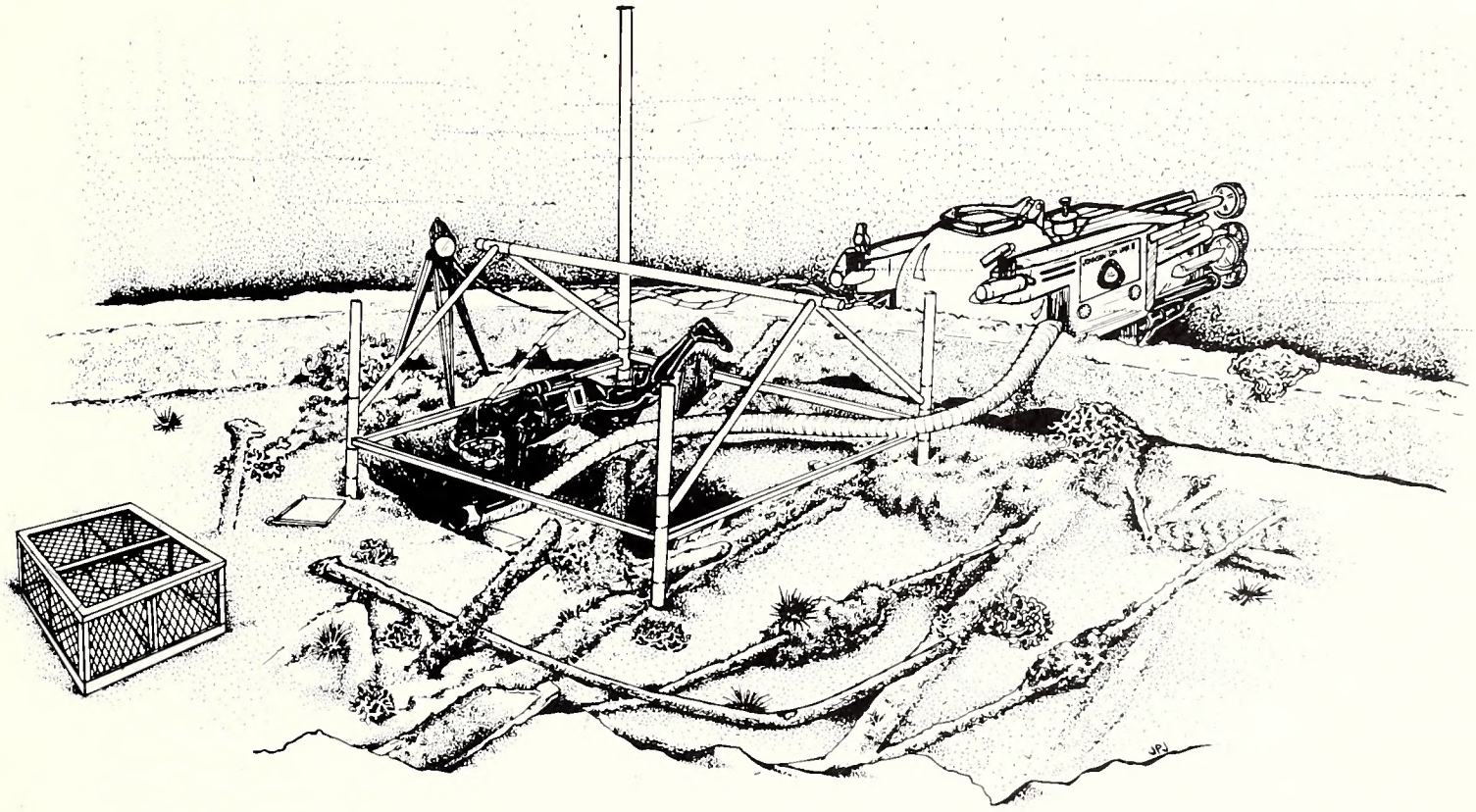


Figure 63. Artist's rendering of excavation in progress.

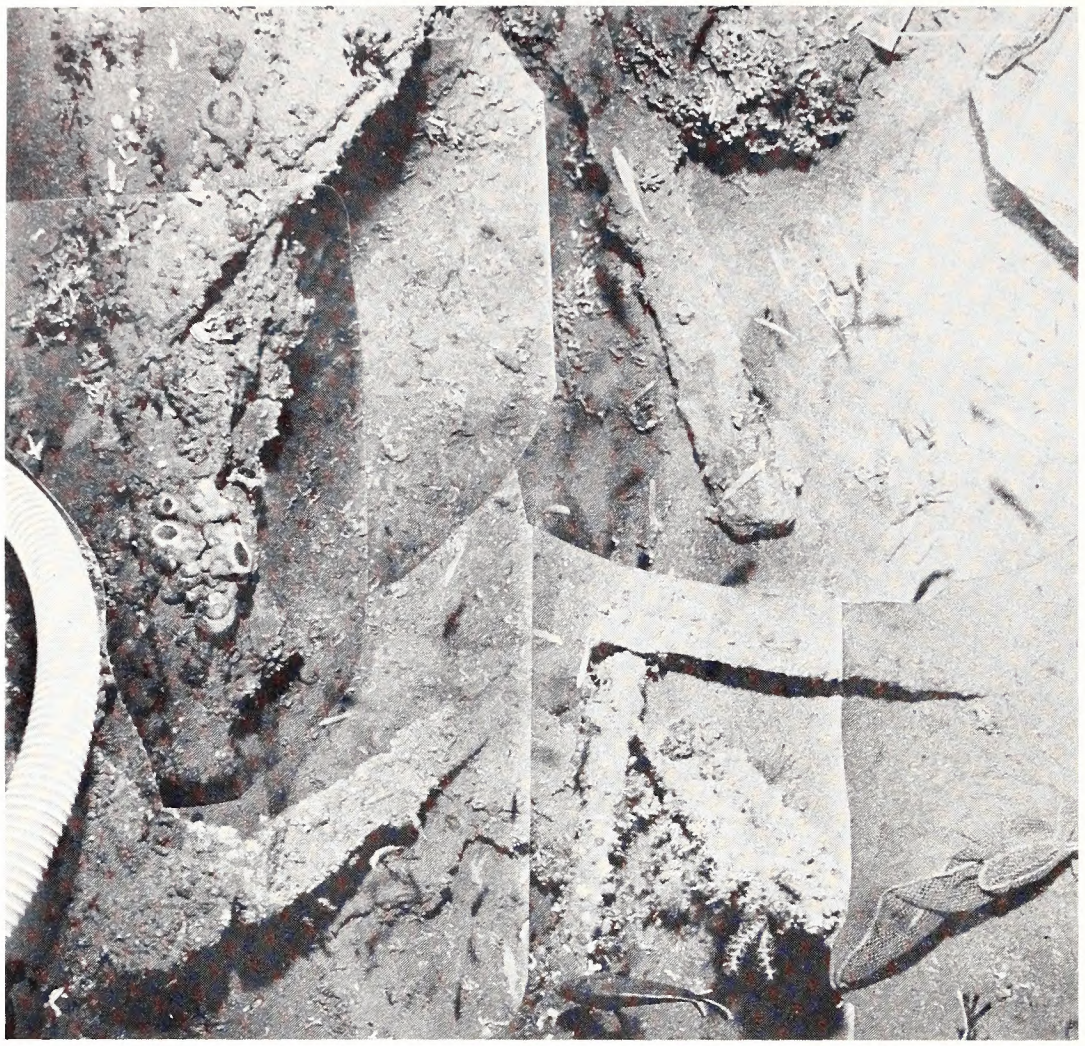


Figure 64. Mosaic of test excavation level 1.

When excavation in the test area reached a depth of 8 inches, structural material exposed in the north half of the grid adjacent to the port armor belt made it obvious that the size of the test would have to be limited to the south portion of the grid. Extensive structural iron and plate along the armor belt were impossible to remove with the equipment available and would have required an extensive amount of bottom time. At this point excavation was limited to a 2-foot-by-5-foot area in the south portion of the grid *(Figure 65)*. Utilizing a sequence of excavation, photography, and mapping, this area of the test was carried to the level of deck beams and planking. Material recovered from the excavation was placed in locking plastic bags and stored inside sealable 5-gallon plastic buckets carried in an aluminum mesh artifact recovery basket. When surface conditions and field preservation arrangements were acceptable, the basket was floated to the surface using a lift bag and taken aboard the R/V *Johnson*. Recovered material was cataloged and transferred to a support vessel for shipment to a temporary field preservation laboratory in Hatteras Village.

To correlate vertical control inside the excavation with the datum established arbitrarily at the underside of the armor belt on the point of the bow, an electronic bubble level was employed. Because mounting the sending unit at the bow as originally intended proved to be unfeasible, it was attached to a strobe mounted on the strongback of the submersible. After the tube was filled with gas from the submersible, a measurement of the elevation at the bow was made. This elevation was then transferred to the grid frame *(Figure 66)*. The actual depth of 226 feet was recorded on the submersible's depth gauge and correlated with the elevation of the sending unit mounted on the strobe. Depth was thus established for both the bow and grid frame and vertical control in the excavation tied to arbitrary datum elevation at the bow.

To assist in establishing the orientation of the hull remains and determining the extent of distortion, a series of inclinometer measurements was made along the armor belt and intact portions of the lower hull *(Figure 67)*. Measurements taken along the armor belt at the amidships bulkhead and adjacent to the excavation produced both longitudinal as well as athwartships data. Immediately aft of the amidships bulkhead additional athwartships data was recorded on the port side and bottom of the hull.

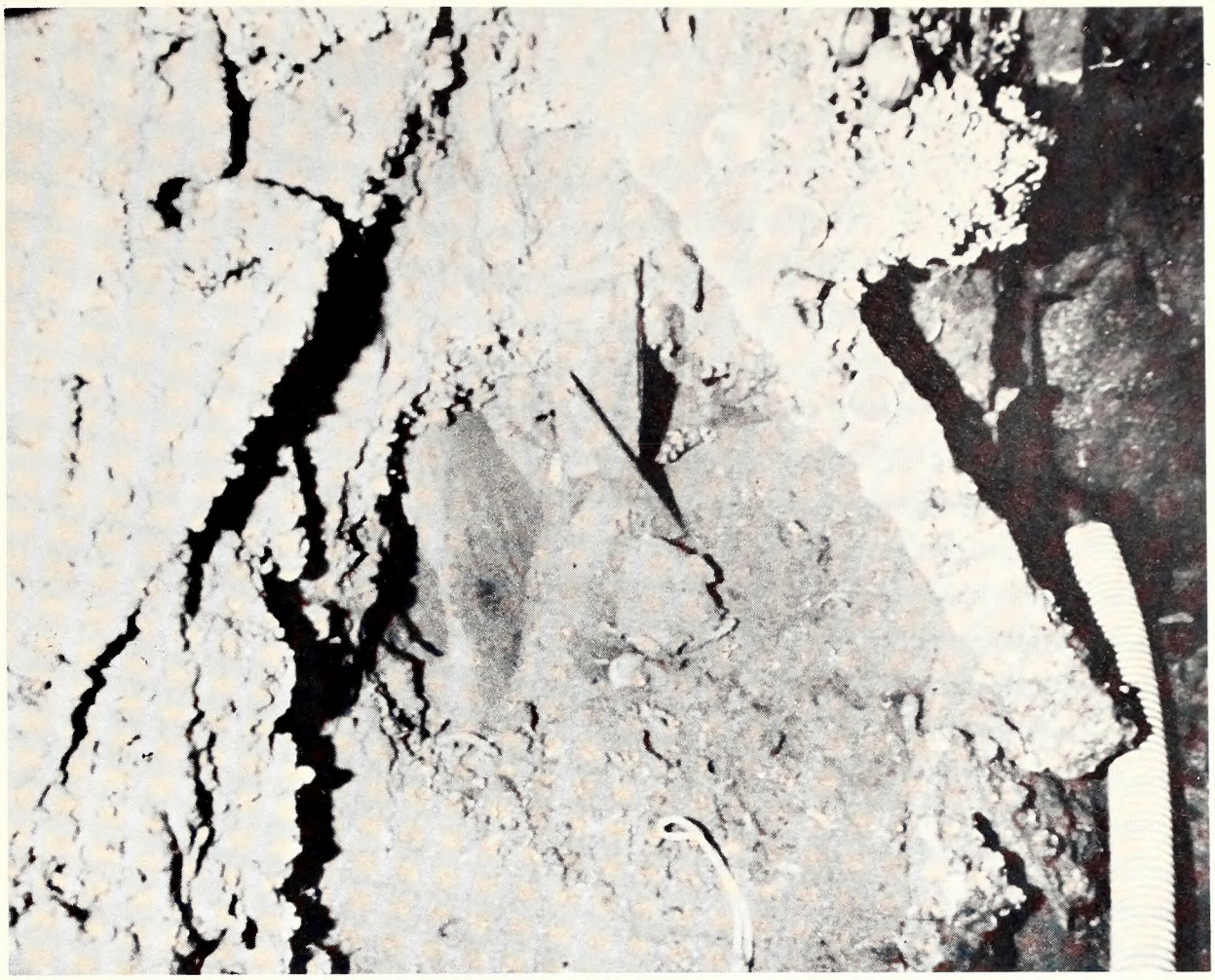


Figure 65. Fragments of wood paneling (left center) and deck beams (right center above dredge intake) exposed in situ in level 4 of the test excavation.

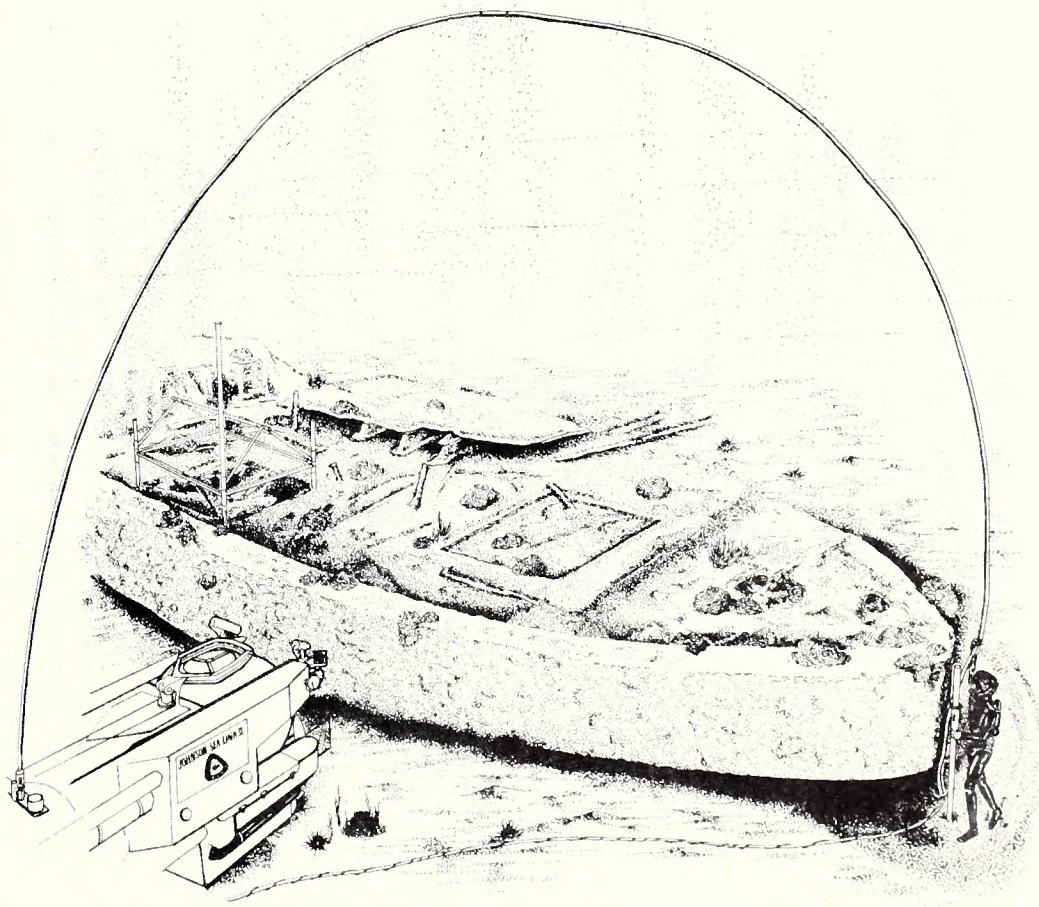


Figure 66. Artist's rendering of diver working with leveling tube.

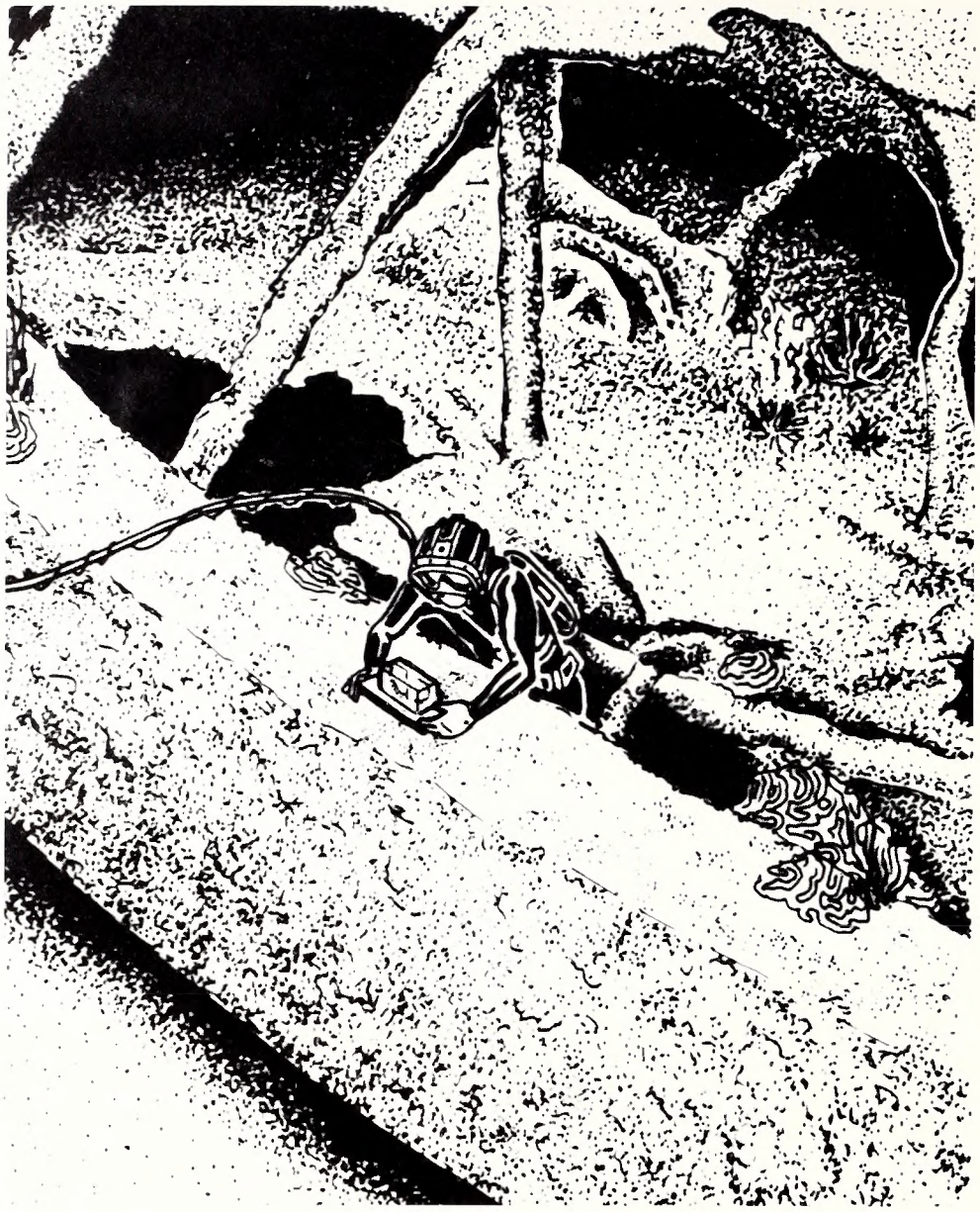


Figure 67. Artist's rendering of diver taking inclinometer readings.

Four additional reconnaissance dives were made aft of the amidships bulkhead. In addition to examining damage to the stern, the interior of intact portions of the lower hull containing the galley and engineering spaces were explored, photographed, and videotaped. Three of these exploratory dives included examinations of the turret and deck structure. Examination of the turret included probing the floor in an effort to identify access hatches and determine the extent and condition of its contents.

As the test excavation neared completion, attention was directed to the examination and documentation of the remainder of the vessel. In an attempt to collect data and material that would answer historical, engineering, and conservation questions, a series of reconnaissance dives was conducted to generate structural observations, documentary photographs, and identify and collect a limited number of surface artifacts that would be useful in determining the status of preservation of as wide a range of materials as possible *(Figure 68)*. With four exceptions, reconnaissance explorations were all carried out following activities in the test excavation. This permitted forward portions of the wreck to be examined and photographed when visibility in the excavation was reduced by sediment stirred into suspension or temperature began to reduce the diver's working efficiency and reliability.

Figure 68. Exploration of the interior of the **Monitor** *aft of the amidships bulkhead generated numerous observations, many of which were documented on closed-circuit television tape and 35 mm. film.*

Immediately prior to the termination of on-site activities two iron samples were recovered. A 6-inch pipe 4 feet in length was recovered from north of the stern and loaded onto the submersible for transportation to the surface. The remains of a davit or stanchion located immediately south of the test excavation was removed from the wreck with a lift bag. A third sample, a 2-foot-by-3-foot-composition of iron plate found 40 feet north of the stern, proved too cumbersome and was redeposited immediately north of the propeller.

Once recovery of material at the site had been completed, a lift bag was attached to the grid frame, and it was likewise transported to the surface. The remaining equipment, including two datum casings displaced by the current, was loaded aboard the submersible for recovery. While initial plans called for covering material exposed by excavation with the entrainment dredge reversed, sediment had accumulated so rapidly in the test area that this was deemed unnecessary. After removing the acoustic beacon that had been placed beside the wreck to facilitate navigation, work at the site was completed.

HANDLING OF ARTIFACTS

Excavation of the test area produced a quantity of artifacts, samples, and other materials that required special handling, recovery, stabilization, cleaning, analysis, and conservation. Once material had been removed from the on-site environment, it was bagged and stored in a specially designed recovery basket until basket volume and surface conditions were conducive to transportation to the surface for recovery by the crew of an inflatable from the R/V *Johnson*. A davit or stanchion, one of two artifacts of considerable size, was recovered using a lift bag for direct lift. The second large artifact, a section of iron pipe, was recovered by placing it aboard the submersible. Extremely fragile material was packaged in individual plastic containers and carried into the submersible's lockout compartment for transportation to the surface.

On board the R/V *Johnson*, artifacts were photographed, cataloged, and repacked in cases constructed for wet storage or transported to Hatteras Village aboard the NOAA support vessel *Laidly*. Once ashore, all materials were transferred to a temporary laboratory facility in Hatteras Village. Under the supervision of a conservator, all material was repacked in temporary containers with fresh water and chemicals or biocides to retard deterioration. At the conclusion of on-site activities material recovered from the test excavation was shipped to the Underwater Archaeology Branch facility at the Fort Fisher State Historic Site near Kure Beach, North Carolina, for cleaning, analysis, and preservation. Because of the lack of laboratory facilities, a number of artifacts requiring complex preservation were shipped to the conservation laboratory at the Division for Historic Preservation, New York State Office of Parks and Recreation, Peebles Island, New York, for stabilization *(Figure 69)*.

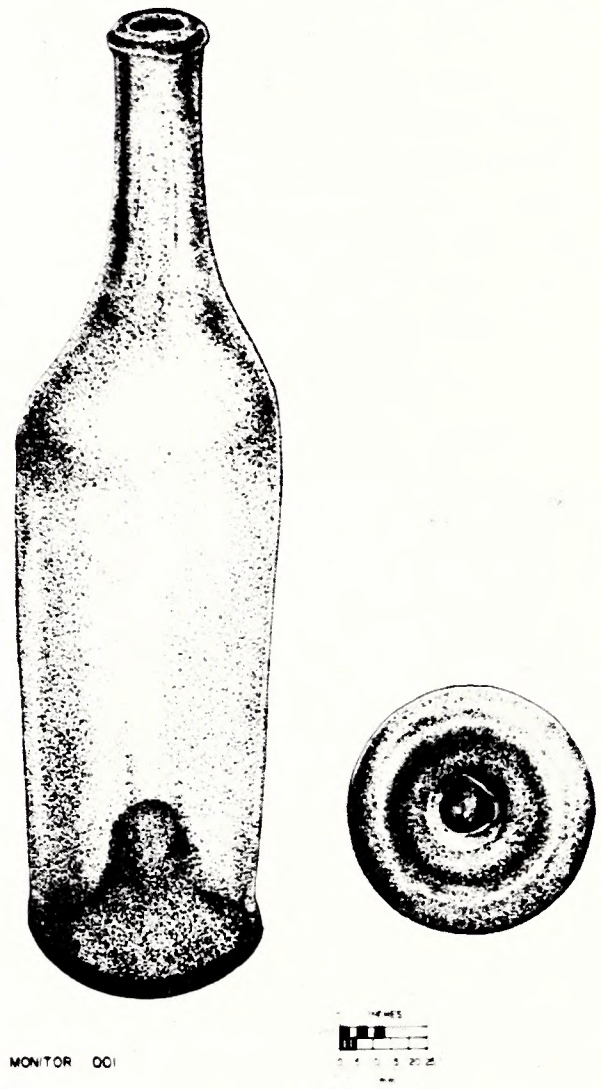
Figure 69. Initial cleaning, cataloging, and conservation were carried out at a temporary laboratory facility at Cape Hatteras prior to shipment to the New York Office of Parks and Recreation's Collection Care facility at Peebles Island.

Figure 70

Artifact: Glass bottle

Monitor: 001

Description: This is a dark green glass, turn-mold wine or champagne bottle. The maximum diameter, measured at the shoulder, is 3 1/8 inches and the height is 11 1/4 inches. A basal kick protrudes into the body 2 7/16 inches and contains a deformed reverse pontil. Shoulders above the 6-inch high molded body are free-blown and constructed to form an off-center neck. The neck terminates immediately above a laid-on ring.



Provenance: Datum station #3 outside the port armor belt and immediately north of the wardroom-vicinity rupture in the foredeck; area E *(Figure 109)*.

Association: Officer's personal effects

Condition: Excellent

Figure *71*

Artifact: Glass storage bottle

Monitor: 002

Description: The light green glass two-piece molded storage bottle is 5 5/16 inches in height.The body is molded to form an octagon 1 11/16 inches in diameter across the embossed flats that measure 11/16 inch in width. At a height of 3 1/2 inches, the vertical walls of the bottle turn to form a rounded shoulder below the base of a 1 3/8-inch diameter round neck. The 1-inch long neck terminates in an interior rolled collar. Two opposing flats, one in each half of the mold, are embossed "U.S. NAVY" and "MUSTARD" in 3/8-inch high letters. The base contains a 1 1/8-inch diameter, 1/8-inch deep circular depression.

Provenance: Surface sediment test excavation; area A *(Figure 109).*

Association: Disturbed

Condition: Excellent

Figure See *Figure 71*

Artifact: Glass storage bottle

Monitor: 007

Description: The light green glass two-piece molded storage bottle is 5 1/4 inches in height. The body is molded to form an octagon 11/16 inches across the embossed flats that measure between 11/16 inches and 3/4 inches in width. At a height of 3 3/4 inches above the base the body turns in to form a rounded octagonal shoulder below the base of a 1 3/8-inch diameter round neck. The 7/8-inch long neck terminates in an interior rolled collar. Two opposing flats, one in each mold half, are embossed "U.S. NAVY" and "PEPPER" in 3/8-inch high letters. The base contains a 1-inch diameter 1/16-inch deep circular depression.

Provenance: Adjacent to port armor belt forward of amidships bulkhead; area D *(Figure 109).*

Association: Galley stores

Condition: Broken; missing portions of three flats

Figure *71*

Artifact: Glass storage bottle

Monitor: 079

Description: The light green glass two-piece molded storage bottle is 5 7/16 inches in height. The body is molded to form an octagon 1 3/4 inches in diameter across embossed flats that measure between 11/16 inch and 3/4 inch in width. At a height of 3 3/4 inches above the base, the body turns in to form a rounded octagonal shoulder below the base of a 1 3/8-inch diameter round neck. The 1 1/4-inch long neck terminates in an interior rolled collar. Two opposing flats, one in each mold half, are embossed "U.S. NAVY" and "MUSTARD" in 3/8-inch high letters. The base contains a 1 3/16-inch diameter, 1/16-inch deep circular depression. A 1/2-inch-thick, 1-inch-diameter cork used to close the bottle was found intact.

Provenance: Adjacent to the port armor belt, forward of amidships bulkhead; area D *(Figure 109).*

Association: Galley stores

Condition: Excellent

Figure 71

Artifact: Glass storage bottle

Monitor: 103

Description: The light green glass two-piece molded storage bottle is 5 7/16 inches in height. The body is molded to form an octagon 1 3/4 inches in diameter across embossed flats that measure between 11/16 inch and 3/4 inch in width. At a height of 3 3/4 inches above the base, the body turns in to form a rounded octagonal shoulder below the base of a 1 3/8-inch diameter round neck. The 1 1/4-inch long neck terminates in an interior rolled collar. Two opposing flats, one in each mold half, are embossed "U.S. NAVY" and "MUSTARD" in 3/8-inch high letters. The base contains a 1 3/16-inch diameter, 1/16-inch deep circular depression.

MONITOR 103

MONITOR 103

Provenance: Adjacent to the port armor belt, forward of amidships bulkhead; area D *(Figure 109).*

Association: Galley stores

Condition: Excellent

Figure 71

Artifact: Glass storage bottle

Monitor: 104

Description: The light green glass two-piece molded storage bottle is 5 7/16 inches in height. The body is molded to form an octagon 1 3/4 inches in diameter across embossed flats that measure between 11/16 inch and 3/4 inch in width. At a height of 3 3/4 inches above the base, the body turns in to form a rounded octagonal shoulder below the base of a 1 3/8-inch diameter round neck. The 1 1/4-inch long neck terminates in an interior rolled collar. Two opposing flats, one in each mold half, are embossed "U.S. NAVY" and "MUSTARD" in 3/8-inch high letters. The base contains a 1 3/16-inch diameter, 1/16-inch deep circular depression. A 1/2-inch-thick, 1-inch-diameter cork used to close the bottle was found intact.

Provenance: Adjacent to the port armor belt, forward of amidships bulkhead; area D *(Figure 109).*

Association: Galley stores

Condition: Excellent

Figure 71

Artifact: Glass storage bottle

Monitor: 105

Description: The light green glass two-piece molded storage bottle is 5 7/16 inches in height. The body is molded to form an octagon 1 3/4 inches in diameter across embossed flats that measure between 11/16 inch and 3/4 inch in width. At a height of 3 3/4 inches above the base, the body turns in to form a rounded octagonal shoulder below the base of a 1 3/8-inch diameter round neck. The 1 1/4-inch long neck terminates in an interior rolled collar. Two opposing flats, one in each mold half, are embossed "U.S. NAVY" and "MUSTARD" in 3/8-inch high letters. The base contains a 1 3/16-inch diameter, 1/16-inch deep circular depression.

Provenance: Adjacent to the port armor belt, forward of amidships bulkhead; area D *(Figure 109).*

Association: Galley stores

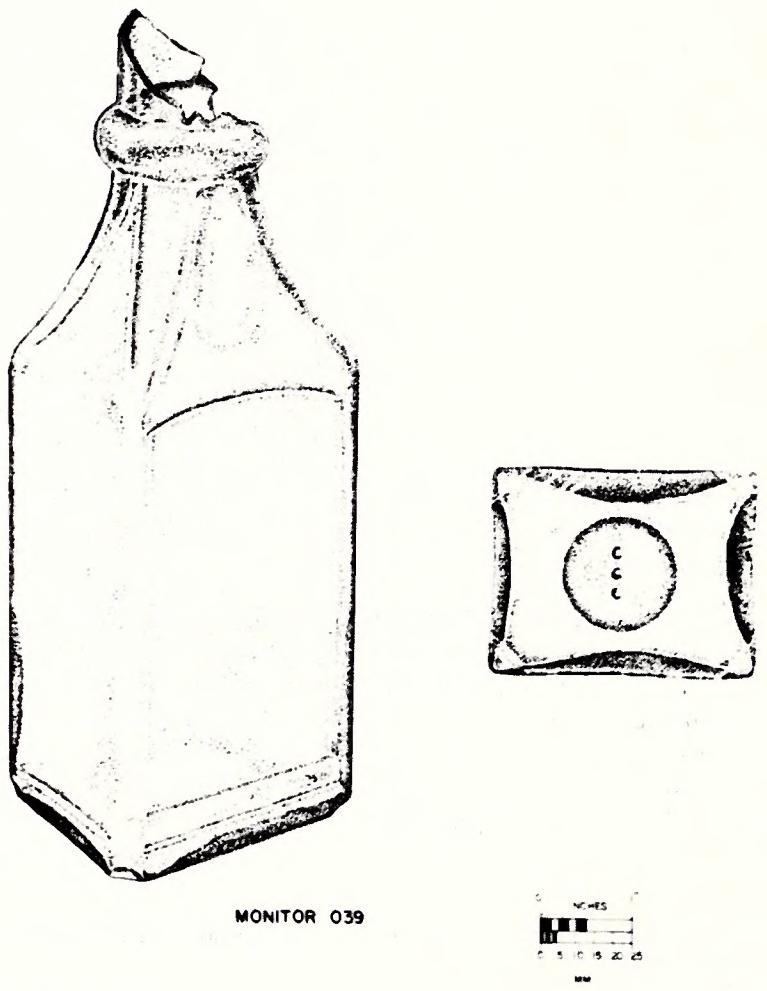
Condition: Excellent

Figure 72

Artifact: Glass storage bottle fragment

Monitor: 039

Description: This is a portion of a light green three-piece molded rectangular food storage bottle. Base measurements are 3 inches by 2 5/16 inches, although each side is slightly concave. A 1 1/2-inch diameter circular depression extends 7/16 inches into the base of the bottle and contains three embossed beads spaced 5/16 inch apart along the short axis of the base. Each corner of the base is eliminated by a mold design clipping the apex and producing a triangular face 1/4 inch in height. The face of the bottle body contains a rectangular recess approximately 1/16-inch deep and arched at the top to permit application of a label. At a height of 5 1/4 inches above the base, the body of the bottle forms a shoulder and converges to form the base of a 1 3/4-inch neck base. Both the front and rear of the bottle contain a teardrop design immediately below the neck and the sides are molded to form an inverted "V." A collar 1 3/4 inches in maximum diameter and 3/4 inch wide serves as the base for a 1 9/16-inch diameter tubular neck.



MONITOR 039

Provenance: Area E *(Figure 109).*

Association: Officer's Effects.

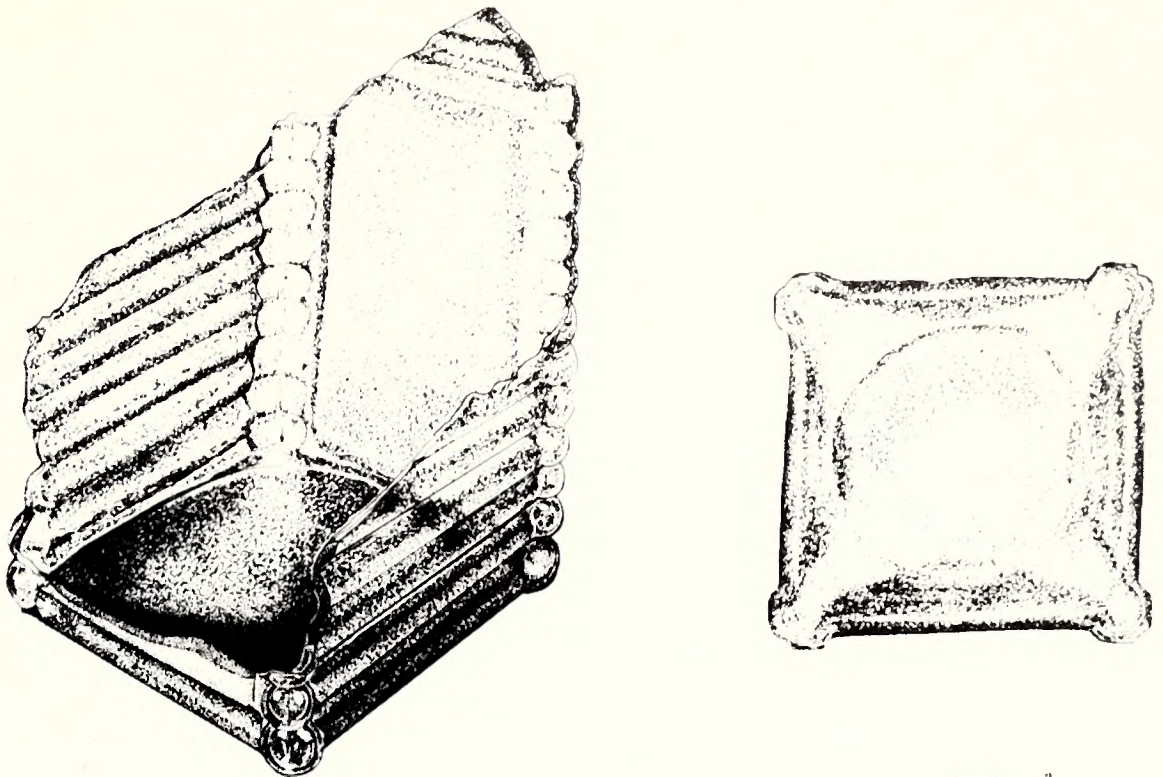
Condition: Broken. Top and portions of the neck are missing.

Figure 73

Artifact: Glass bitters bottle fragment

Monitor: 041

Description: The amber bottle base fragment measures 3 inches square. The slightly concave base of the fragment contains a 3/16-inch deep circular depression 2 1/8 inches in diameter. The sides of the body are formed to simulate log cabin construction features with 3/8-inch diameter logs forming joints at the corner of the bottle. Above the first "log," two sides of the body are recessed and molded flat to form a rectangle 3 7/16 inches in height and 1 3/4 inches in width. Above this the molded logs continue to form the sides.



Provenance: Immediately inboard of the port armor belt; area C *(Figure 109).*

Association: Officers' quarters

Condition: Broken base fragment

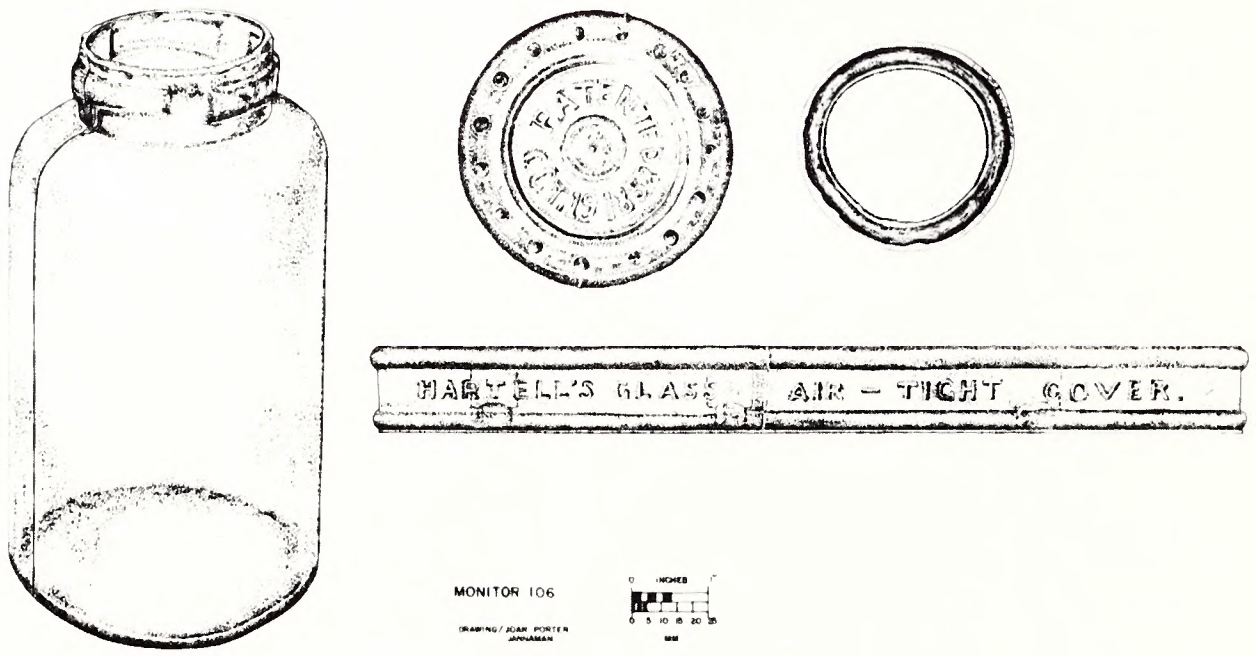
Figure 74

Artifact: Hartell's Glass storage jar with lid and rubber seal

Monitor: 106

Description: The light green glass two-piece vertical mold storage jar is 4 5/16 inches in diameter and 8 inches in height. Three 2-inch long, 1/2-inch wide lugs are located equidistant around the circumference of the neck, 1/8 inch below the ground mouth of the jar. The walls of the jar are vertical and turn into the vessel to form a round shoulder between 6 and 7 inches from the base. Above the shoulder, a 2 5/8-inch neck rises an additional inch. Lugs increase the diameter of the neck to 2 7/8 inches. Although still intact, the entire circumference of the base exhibits a clean crack at the junction of the wall and base. The vessel contains no embossing.

The 3 5/8-inch diameter lid was produced in a complex four or five piece mold from light green glass. Outside a 7/8-inch diameter ring in the center of the top, 5/16-inch embossing preserves the patent date "Oct. 19 1858." Outside a second 2 3/8-inch concentric circle, 16 equally-spaced conical beads occupy the lid surface adjacent to a reinforcing ring forming the shoulder connecting the top and sides of the lid. A 1/2-inch flat located between the top and bottom reinforcing rings is embossed "HARTELL'S GLASS AIR TIGHT COVER." The interior of the top of the lid contains a 2 5/8-inch wide, 3/16-inch deep groove that contains a white natural rubber seal of the same dimensions. Inside the lid wall three 1/8-inch thick, 3/8-inch wide, 1/2-inch long lugs are positioned equidistant around the circumference.



Provenance: Recovered from debris collecting along the north side of the rupture in the deck above the wardroom; area B *(Figure 109).*

Association: Officer's effects

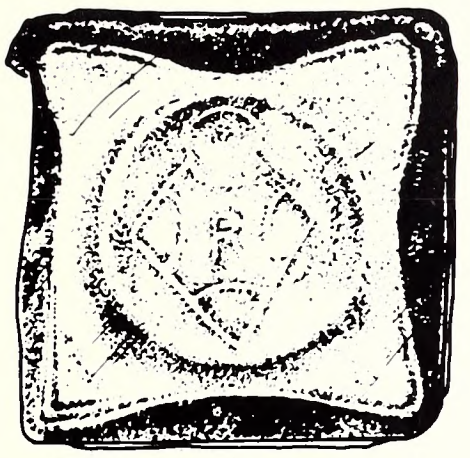
Condition: Excellent

Figure 75

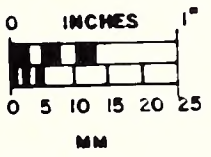
Artifact: Glass bottle fragment

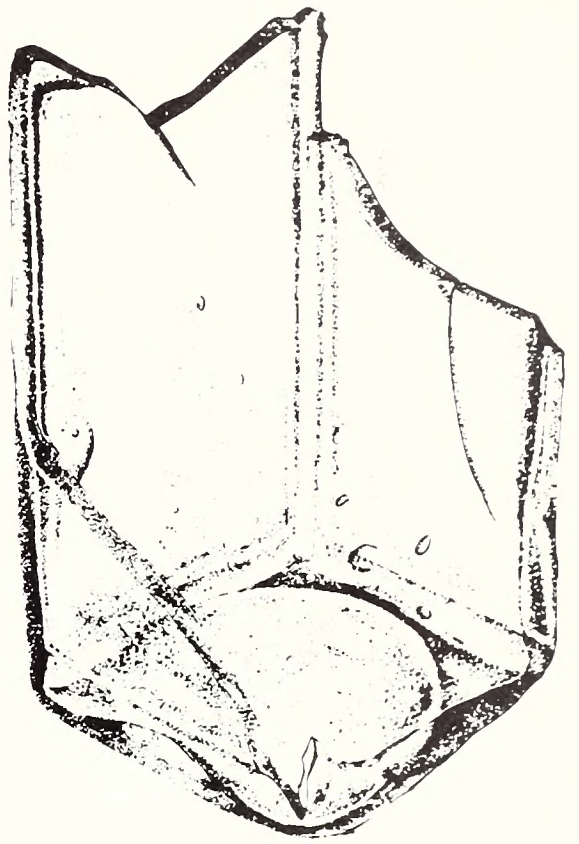
Monitor: 108

Description: The light green glass bottle base measures 2 5/8 inches square. A 1 3/4-inch circular depression recessed 1/2 inch into the base contains an embossed pentagon with a semicircular crown containing three vertical bars at the top of the one short side. Each angle of the pentagon and the short side is isolated from the interior space by an arc. The center space is occupied by a Capital "R" and a smaller capital "D" to the right and above the "R." Corners of the body are molded to form half-round columns and the remains of three of the sides contain evidence of a raised panel. On the largest side, this raised panel measures 4 1/4 inches in height, 2 1/8 inches in width, and is raised 1/8 inch above the body.

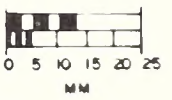


MONITOR 108





MONITOR 108



Provenance: Area C *(Figure 109).*

Association: Officer's effects.

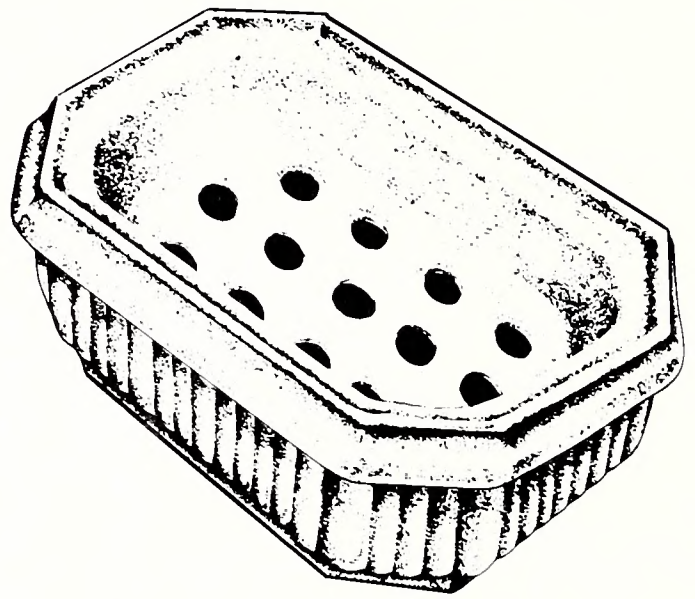
Condition: Base fragment containing portions of three sides

Figure 76

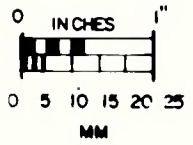
Artifact: Porcelain soap dish (two pieces)

Monitor: 115

Description: The white porcelain base is 4 3/8 inches long, 3 1/8 inches wide, and 1 5/16 inches high. Wall thickness on the eight-sided dish varies between 1/8 inch and 3/16 inch. From the base each of the fluted sides of the dish flair out before proceeding vertically to terminate in a reinforcing rim at the top. The strainer measures 4 1/16 inches in length, 3 3/4 inches in width, and 1 1/16 inches in total depth. From the base, penetrated by thirteen symmetrically-arranged 5/16-inch diameter drain holes, the sides of the strainer rise to form a 3 3/4-inch long, 2 3/16-inch wide, 3/4-inch deep storage area for bar soap. The strainer fits into the dish and is maintained in place by a depression cast into the underside of its reinforcing rim. An additional reinforcing rim on top of the strainer forms a second depression designed to contain a cover that corresponded to the fluted design of the dish.



MONITOR 115



Provenance: Deck level in the test excavation; area A *(Figure 109).*

Association: Officer's issue materials

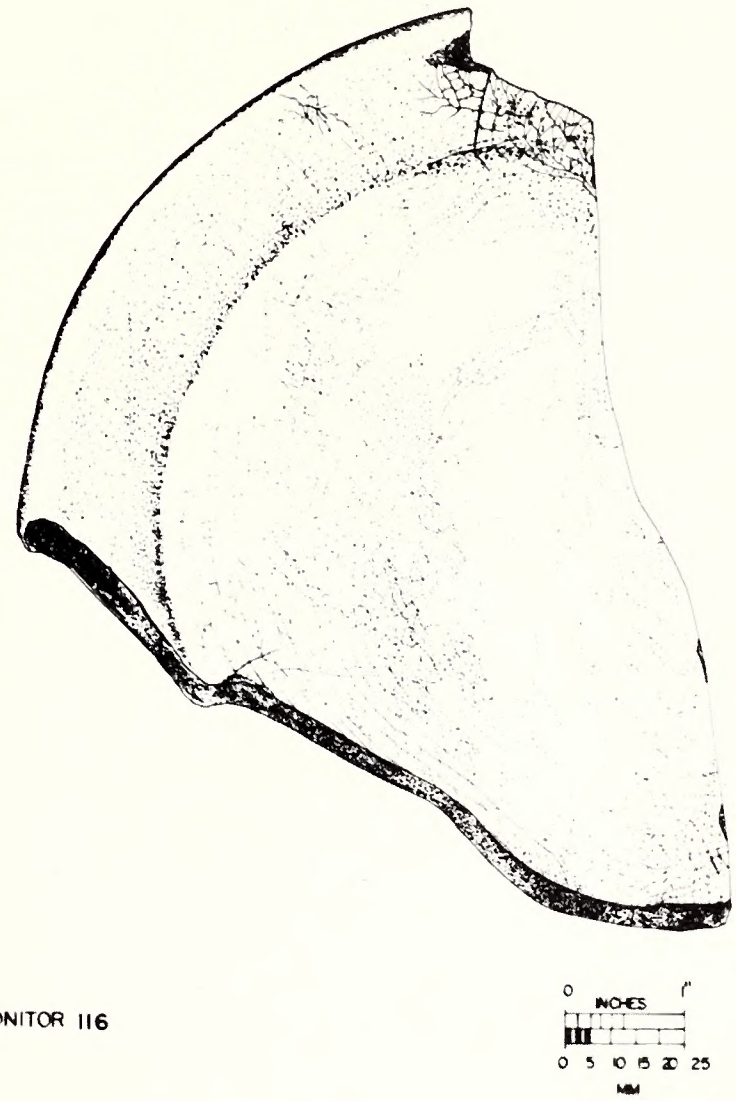
Condition: Excellent

Figure 77

Artifact: Ironstone plate fragment

Monitor: 116

Description: This is a fragment of a 9 1/2-inch diameter, 1 1/16-inch deep ironstone plate with no markings.



Provenance: Recovered from debris collecting along the north side of the rupture in the deck above the wardroom; area B *(Figure 109)*.

Association: Officer's issue material

Condition: Good

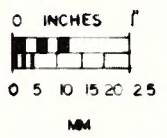
Figure 78

Artifact: Brass lamp base

Monitor: 043

Description: The brass lamp base is 5 7/16 inches in maximum diameter and 3 3/4 inches in height and contains number 8 lead shot and leather inset. The four-piece base consists of a 1 1/2-inch high, 1/32-inch thick undecorated base ring. To the top of this base a 5 1/8-inch diameter, 1/32-inch thick, 7/8-inch wide brass ring has been soldered in place. The second ring has been pressed to form a 5/16-inch deep horizontal groove in the base. A third ring 5 1/16 inches in diameter and decorated with a stamped design of alternate circles and parallelograms fits into the second ring. Two horizontal reinforcing bands on the ring contain the design and form joints to permit assembly. Above this third ring a fourth forms a concave shoulder and reduces the base diameter to 4 inches. A distinct lip on the lower surface of the ring combines with the third ring to form a solderable joint. The top likewise forms a recessed ring designed to be compatible with missing parts of the lamp. Inside the first two rings of the lamp, the base has been filled with number 8 lead shot. Originally these appear to have been poured into the base and settled around some interior feature. As a result, the shot forms a 13/16-inch thick ring inside the base wall. The bottom of the base additionally contains a 3 3/4-inch decorated recessed leather base with two off-center holes of 1/4-inch and 1/2-inch diameter.

MONITOR 043



Provenance: Datum station 3; area E *(Figure 109).*

Association: Wardroom

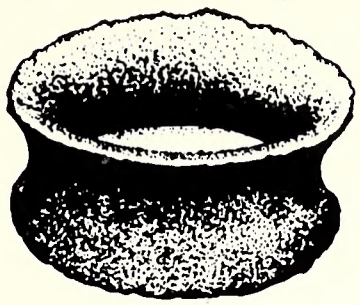
Condition: Good

Figure 79

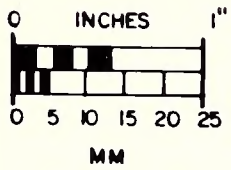
Artifact: Brass thimble

Monitor: 011

Description: The brass thimble is 1 11/16 inches in maximum diameter with a 1 1/8-inch interior diameter.



MONITOR 011



Provenance: Test excavation level 4; area A *(Figure 109).*

Association: Officer's issue material or effects

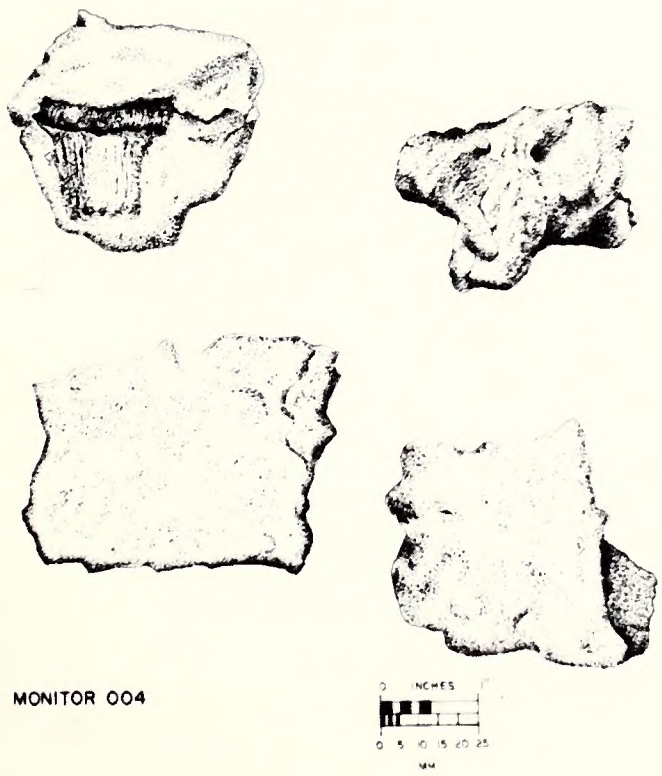
Condition: Good

Figure 80

Artifact: Concretions, three unidentified, one rivet-formed

Monitor: 004

Description: The rivet-formed concretion fragment preserves physical characteristics and dimensions of a rivet. The overall length of the rivet is 1 5/8 inches; the shaft is 1 inch long; the diameter is 3/4 inches; and the maximum head diameter is 3/16 inches. Three of the concretions are unidentified.



MONITOR 004

Provenance: Test excavation level 3; area A *(Figure 109).*

Association: Lower hull

Condition: Stable

Artifact: Concretion

Monitor: 077

Description: The concretion fragment preserves the physical characteristics of a rivet. The rivet depression length is 1 3/4 inches, the shaft is 1 1/4 inches long, 3/4 inches in diameter, and the head diameter is 1 1/8 inches.

Provenance: Test excavation level 3; area A *(Figure 109).*

Association: Lower hull

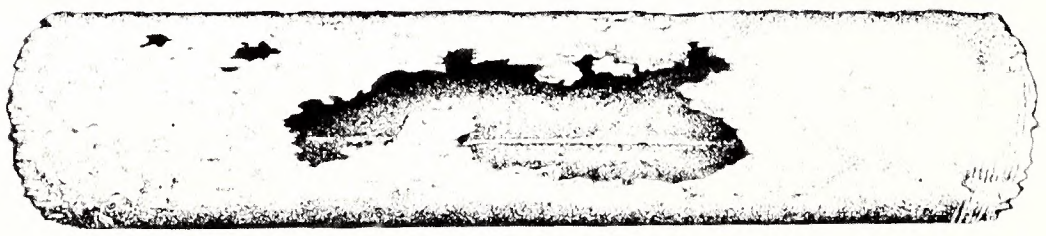
Condition: Stable

Figure *81*

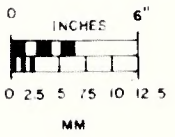
Artifact: Iron pipe

Monitor: 110

Description: The section of wrought iron pipe is 6 5/8 inches in outside diameter and 48 inches long. From a single piece of 1/4-inch plate, the section is rolled to form a longitudinal butted seam that was heat- and pressure-welded. One end of the section is threaded for a length of 2 inches with eight threads formed per inch.



MONITOR 110



Provenance: Surface sediment under the port quarter aft of the turret; area G *(Figure 109).*

Association: Lower hull engineering space

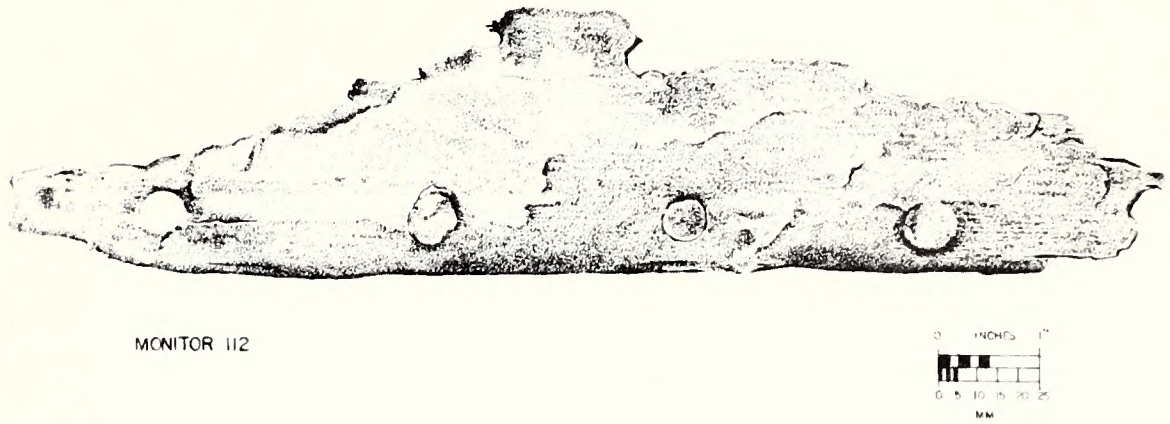
Condition: Good

Figure 82

Artifact: Iron pipe fragment

Monitor: 112

Description: The fragment of iron pipe is 11 1/2 inches long, 2 3/4 inches wide, and 1/4 inch thick. It is rolled to form a four-inch diameter tube. Four rivet holes are located 5/8 inch from the single remaining finished edge and drilled on 2 1/2-inch centers. Three of the 7/16-inch diameter holes contain the remains of rivets. A second line of rivets was located parallel to and 1 3/4 inches from the first.



Provenance: Test excavation level 3; area G *(Figure 109).*

Association: Lower hull fittings

Condition: Good

Figure 83

Artifact: Iron stanchion

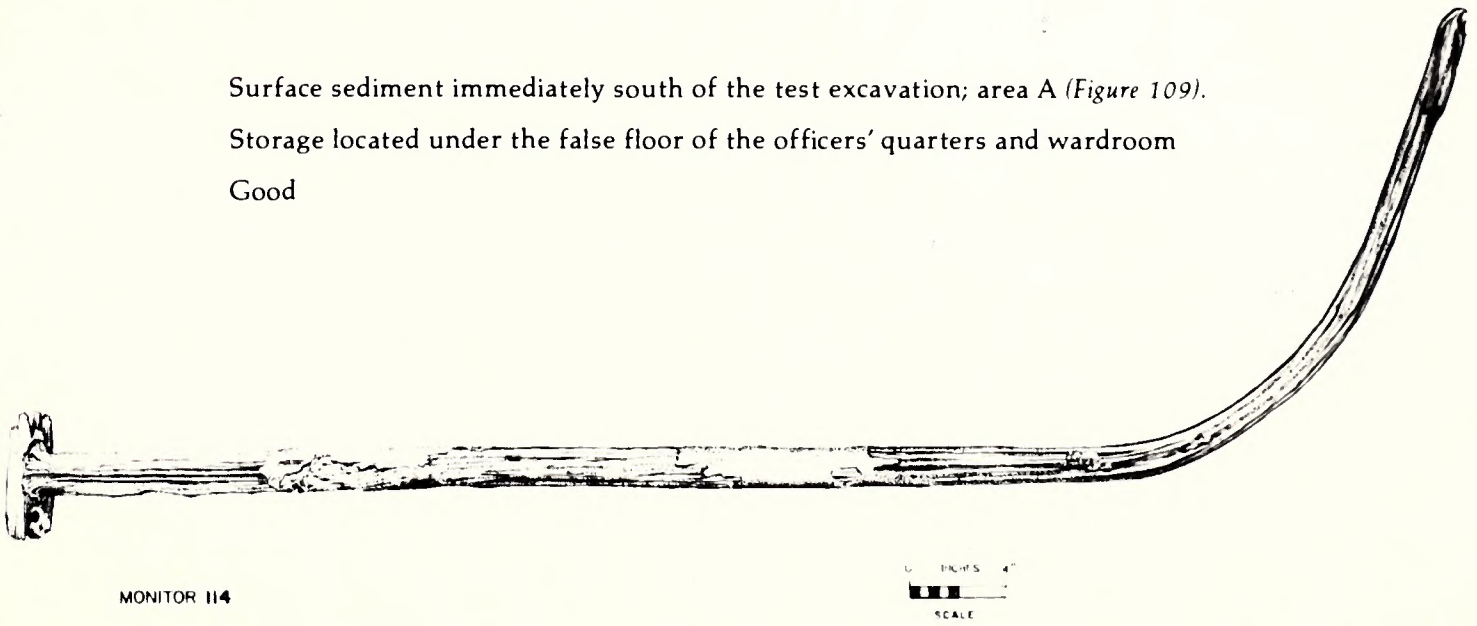
Monitor: 114

Description: The wrought iron stanchion is 2 1/2 inches in diameter and 106 1/2 inches in overall length. The base of the stanchion is forged into the center of a 2 1/2-inch-by-8-inch-by-1 3/4-inch solid wrought iron base. On either side of the stanchion the base was drilled to accept 3/4-inch bolts and countersunk 1/4 inch for a 1 1/4-inch head or nut. The curvature of the stanchion places the upper extremity 91 1/4 inches above the level of the bottom of the base. A semicircular depression, distortion of the striations, and remnants of additional iron forged perpendicular to the stanchion on the upper end suggest that an iron ring or other fitting had been permanently attached.

Provenance: Surface sediment immediately south of the test excavation; area A *(Figure 109).*

Association: Storage located under the false floor of the officers' quarters and wardroom

Condition: Good



Artifact: Unidentified concretions

Monitor: 038; 068; 078; 086; 089; 093; 098; 099; 101; 102; 109

Description: These are unidentified concretions.

Provenance: Test excavation level 3; area A *(Figure 109).*

Association: Lower hull structure

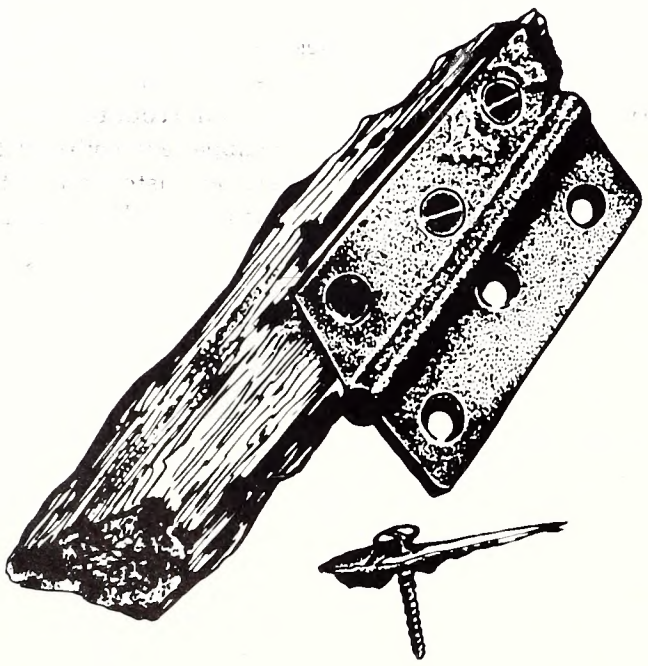
Condition: Stable

Figure 84

Artifact: Wood fragments and attached hinge

Monitor: 005

Description: The larger fragment of pine measures 5 inches by 1 5/8 inches in width and is dressed 7/8 inch thick. The surviving finished edge has been inletted for and contains a 2 1/2-inch long, 2 1/8-inch wide (extended) brass cabinet hinge. Three 1-inch long #12 screws attach the hinge to the wood fragment. A fourth 1-inch #12 flathead wood screw located in the opposite side of the hinge retains a small fragment of wood, also inletted to accept the hinge. The finished surface of the larger wood fragment additionally conains two nail holes driven perpendicular to and between the screws retaining the hinge. Concretion patterns on the face of the fragment indicate that the nails attached a 2-inch wide piece of wood perpendicularly to the first piece.



Provenance: Test excavation level 4; area A *(Figure 109).*

Association: Joinery from officers' quarters

Condition: Hinge, good; wood, fair.

MONITOR 005

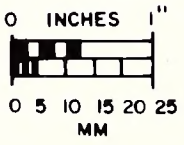
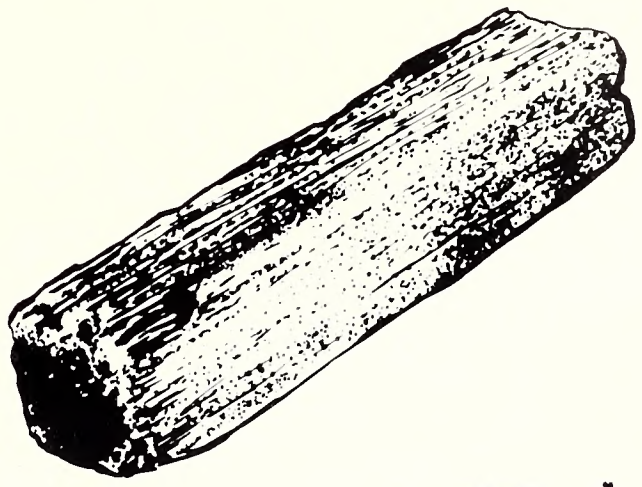


Figure 85

Artifact: Wood fragment

Monitor: 006

Description: The fragment of fir is 3 5/16 inches long, 7/8 inch wide, and 3/4 inch thick.



Provenance: Test excavation level 4; area A *(Figure 109).*

Association: Construction debris

Condition: Excellent

Figure 86

Artifact: Wood fragment, concreted

Monitor: 040

Description: The concreted fragment of pine is 11 1/4 inches long, 3 3/8 inches wide, and 2 inches thick. One end contains a concretion preserving evidence that a cylindrical iron object approximately 2 3/8 inches in diameter passed through the fragment at an angle of 60 degrees. A joint running longitudinally along one side of the wood indicates that the piece is a composite. A line of small brass tacks placed roughly on 1-inch centers indicates that the wood may have been covered by leather or fabric.

Provenance: Test excavation level 3; area A *(Figure 109).*

Association: Joinery from officers' quarters

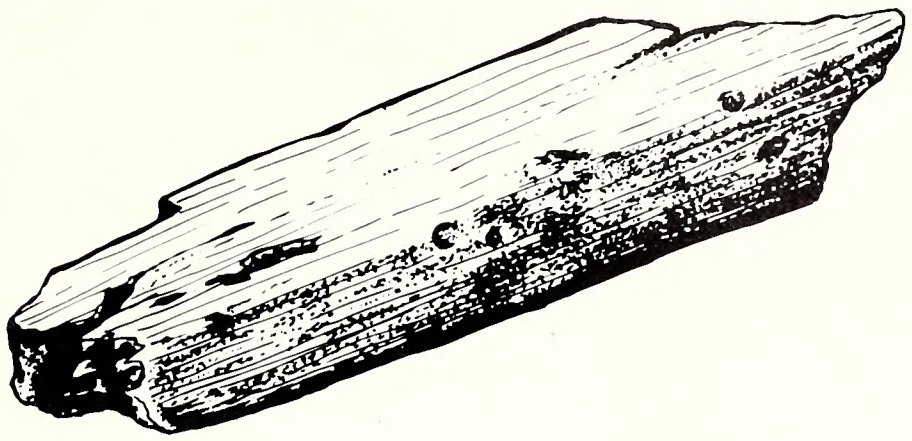
Condition: Fair

Figure 87

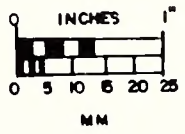
Artifact: Wood fragment

Monitor: 049

Description: The fragment of pine is 6 3/4 inches in length, 2 1/4 inches maximum width, and 1 inch in dressed thickness. Two nail holes, 2 1/2 inches apart, were identified on the one remaining edge surface.



MONITOR 049



Provenance: Test excavation level 4; area A *(Figure 109).*

Association: Joinery from officers' quarters

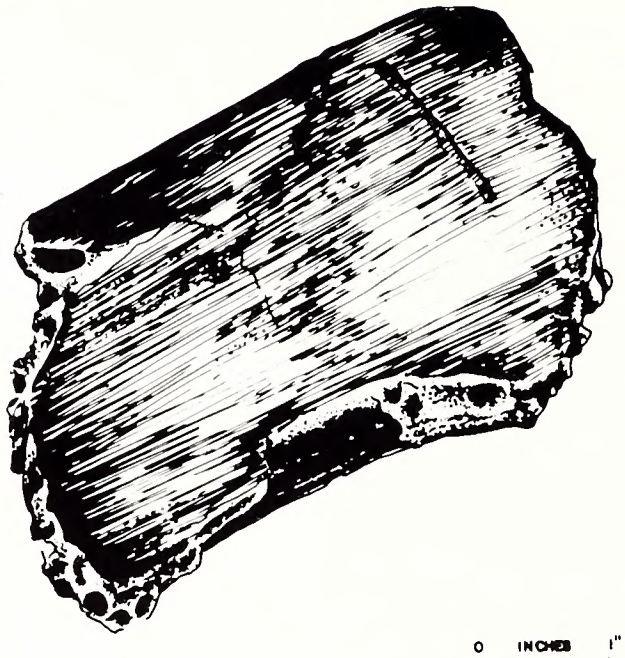
Condition: Good

Figure 88

Artifact: Wood fragment

Monitor: 050

Description: The fragment of pine is dressed 7/8 inch in thickness. Two small nail holes are spaced 3 inches apart on the surviving finished edge. Total length is 5 inches.



MONITOR 050

Provenance: Test excavation level 4; area A *(Figure 109).*

Association: Joinery from officers' quarters

Condition: Good with some teredo damage

Artifact: Wood fragment

Monitor: 051

Description: The fragment of pine is 14 inches long, 2 3/8 inches wide, and 1 1/4 inches thick. Two nail holes in the remaining finished side are located on 1-inch centers and retain the impression of 5/16-inch-by-5/16-inch square heads. A similar nail hole penetrates the fragment diagonally through the remaining finished edge on the approximate center line of the previous holes.

Provenance: Test excavation level 4; area A *(Figure 109).*

Association: Joinery from officers' quarters

Condition: Poor with extensive teredo damage

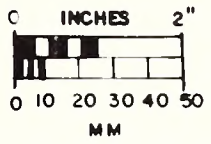
Figure 89

Artifact: Wood louver

Monitor: 052

Description: The pine louver is 11 9/16 inches long, 1 7/8 inches wide, and 1/4 inch thick. Edges of the louver have been finished half-round and both ends have been cut away 1/8 inch for a distance of 1/2 inch from the half-round edge to leave a 9/16-inch-by-1/8-inch lug for mounting in a nonadjustable frame.

MONITOR 052



Provenance: Test excavation level 4; area A *(Figure 109).*

Association: Joinery from officers' quarters

Condition: Excellent

Artifact: Wood fragment

Monitor: 053

Description: The fragment of white pine is 3 1/8 inches long, 3/4 inch maximum width, and 5/16 inch thick. Two different types of saw marks are preserved on the finished faces.

Provenance: Test excavation level 4; area A *(Figure 109).*

Association: Joinery from officers' quarters

Condition: Excellent

Artifact: Wood fragment

Monitor: 054

Description: The fragment of pine is 7 1/8 inches long, 2 1/2 inches maximum width, and 3/8 inch maximum thickness.

Provenance: Test excavation level 4; area A *(Figure 109).*

Association: Joinery from officers' quarters

Condition: Good

Figure 90

Artifact: Wood fragment

Monitor: 056

Description: The pine fragment is 3 1/4 inches long, 1 5/8 inches wide, and 3/8 inch thick.

Provenance: Test excavation level 4; area A *(Figure 109).*

Association: Joinery from officers' quarters

Condition: Excellent

Artifact: Wood fragment

Monitor: 057

Description: The fragment of pine is 7/8 inch dressed thickness.

Provenance: Test excavation level 4; area A *(Figure 109).*

Association: Joinery from officers' quarters

Condition: Poor

Artifact: Wood fragment

Monitor: 058

Description: The fragment of pine is 1 3/4 inches long, 5/8 inch maximum width, and 3/8 inch dressed width.

Provenance: Test excavation level 4; area A *(Figure 109).*

Association: Joinery from officers' quarters

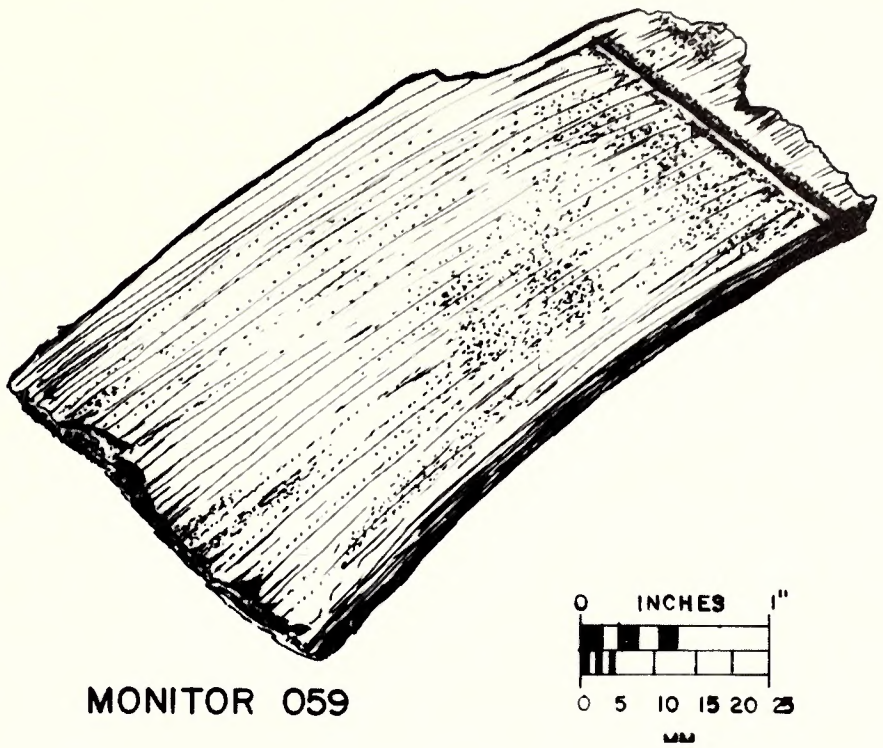
Condition: Good

Figure 91

Artifact: Wood cask stave fragment

Monitor: 059

Description: The oak cask stave fragment is 4 1/8 inches in length, 2 1/8 inches in width, and 1/4 inch in thickness. The surviving finished end has been beveled and notched to accept the base or head of the cask.



MONITOR 059

Provenance: Test excavation level 4; area A *(Figure 109).*

Association: Officers' effects

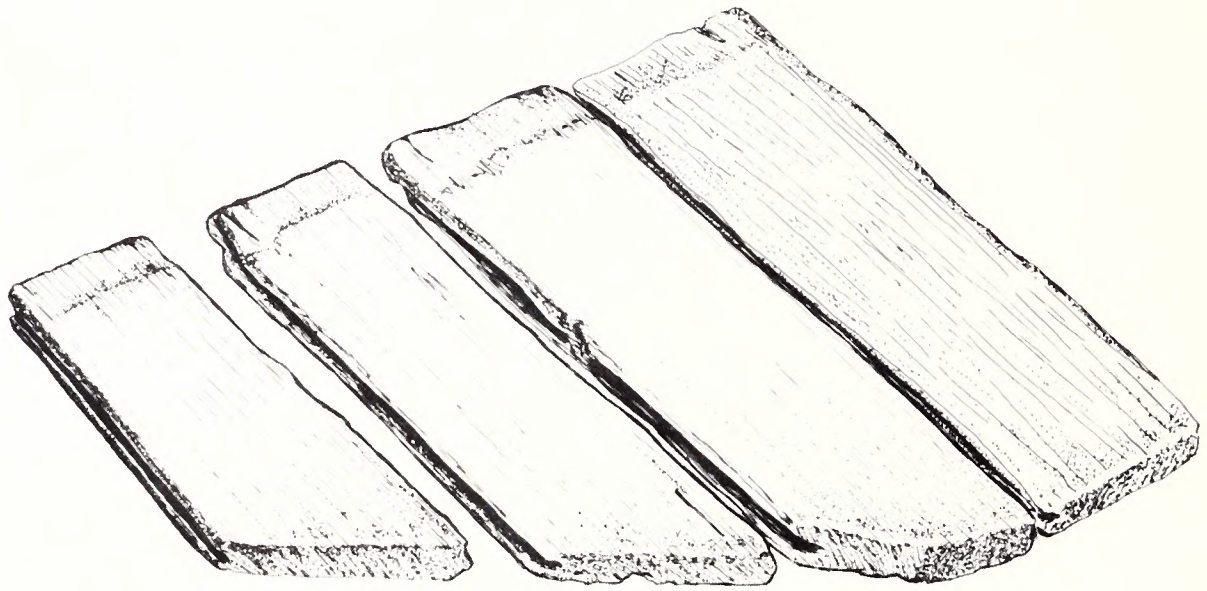
Condition: Good

Figure 92

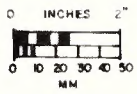
Artifact: Tongue-and-groove paneling

Monitor: 060, 062, 063, 064

Description: These are four matching sections of mahogany tongue-and-groove paneling. Dressed to a thickness of 7/8 of an inch, each of the 3 1/2-inch wide sections is complete with finish cuts on each end. In addition to the tongue, that edge is decorated with a half-round bead. The longest of the four sections is cut to a length of 12 5/8 inches. One corner is cut away on a 45-degree angle. The adjoining section is cut at a 45-degree angle to a maximum length of 11 inches. Likewise, the remaining section is cut on a 45-degree angle to maximum lengths of 8 1/4 inches. On the square cut end of each section, the undecorated or reverse side has been reduced to a thickness of 5/8 inch to 3/4 inch across the final 1 1/4 inch. Nail holes in the sections, two near each corner of the square end and one through the tongue and out the diagonal end, indicate that the paneling was applied beginning with the shortest piece and terminating with the longest. The fourth piece is cut square on the ends and measures 12 5/8 inches in length, 2 inches in maximum width, and is also 7/8-inch thick.



MONITOR 062, 063, 064, 065



Provenance: Test excavation level 4; area A *(Figure 109).*

Association: Joinery from officers' quarters

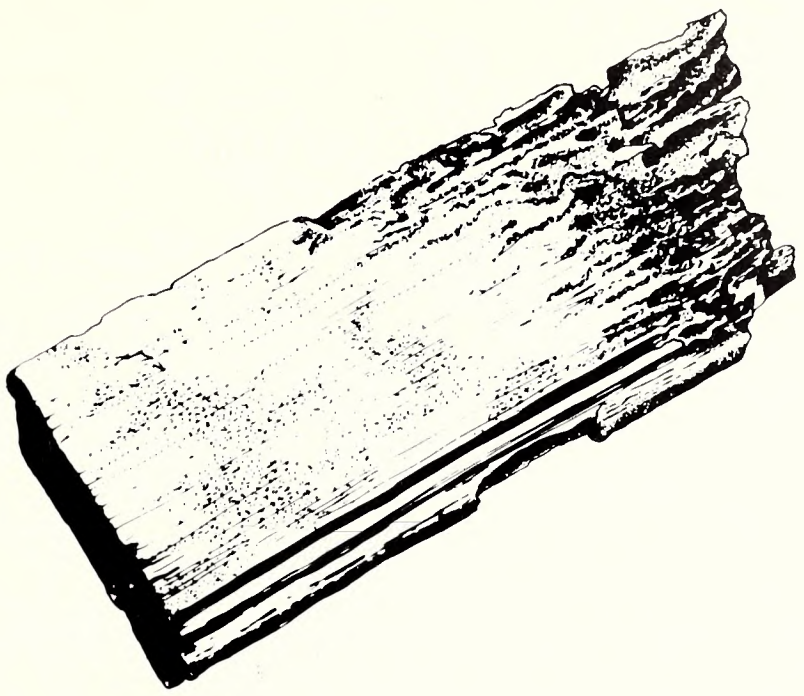
Condition: Good

Figure 93

Artifact: Tongue-and-groove paneling

Monitor: 061

Description: The fragment of pine tongue-and-groove paneling is 7 7/8 inches long, 3 1/2 inches wide, and 7/8 inch thick. Adjacent to and running parallel with the tongue, the remains of a decorative half-round bead is in evidence on both width surfaces.



Provenance: Test excavation level 4; area A *(Figure 109).*

Association: Joinery from officers' quarters

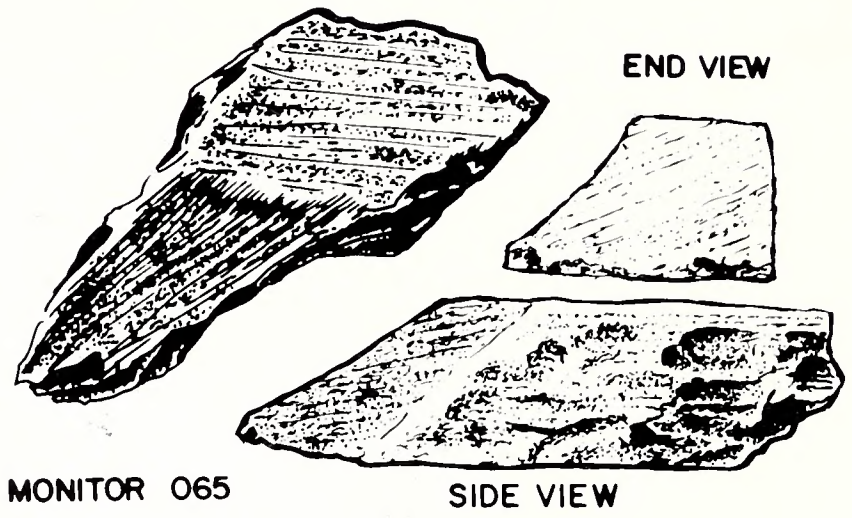
Condition: Poor

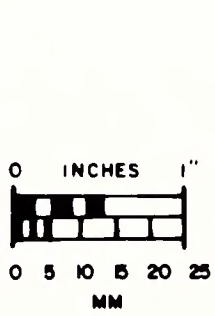
Figure 94

Artifact: Wood fragment

Monitor: 065

Description: The fragment of pine is 3 7/8 inches in length, 1 1/2 inches in width, and 7/8 inch in thickness. The surviving finished end has been cut on a 35-degree by 60-degree angle.





Provenance: Test excavation level 4; area A *(Figure 109).*

Association: Joinery from officers' quarters

Condition: Good

Artifact: Wood fragment

Monitor: 066

Description: The fragment of fir is 5 5/8 inches long, 1 5/8 inches maximum width, and 5/8 inch maximum thickness.

Provenance: Test excavation level 4; area A *(Figure 109).*

Association: Joinery from officers' quarters

Condition: Good

Artifact: Wood fragment

Monitor: 067

Description: The fragment of fir measures 5 1/2 inches in length, 1 9/16 inches in maximum width, and 1/2 inch in maximum thickness. The fragment contains one dressed side and dressed and beveled edge.

Provenance: Test excavation level 4; area A *(Figure 109).*

Association: Joinery from officers' quarters

Condition: Fair

Artifact: Wood fragment

Monitor: 068

Description: The fragment of pine is 4 1/2 inches long, 2 3/4 inches wide, and 7/8 inch dressed thickness.

Provenance: Test excavation level 4; area A *(Figure 109).*

Association: Joinery from officers' quarters

Condition: Good

Artifact: Wood fragment

Monitor: 069

Description: The fragment of pine is 8 1/2 inches long, 2 1/4 inches wide, and 3/4 inch thick. One surviving finished edge contains a series of four randomly placed nail holes.

Provenance: Test excavation level 4; area A *(Figure 109).*

Association: Joinery from officers' quarters

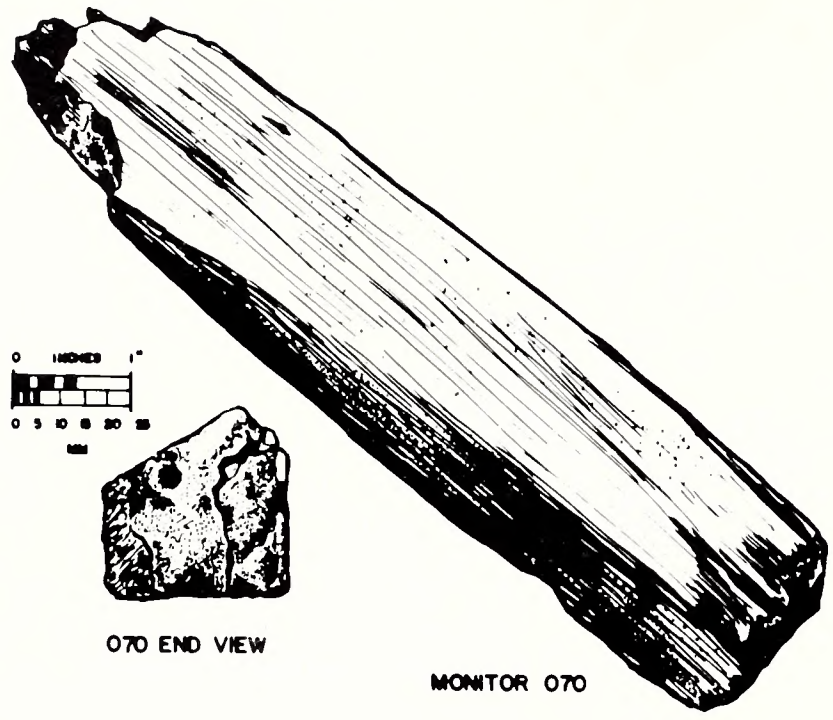
Condition: Poor with extensive teredo damage

Figure 95

Artifact: Wood fragment

Monitor: 070

Description: The fragment of pine corner molding is 8 1/2 inches long, 1 5/8 inches maximum thickness, and 1 1/2 inches maximum width.



Provenance: Test excavation level 4; area A *(Figure 109).*

Association: Joinery from officers' quarters

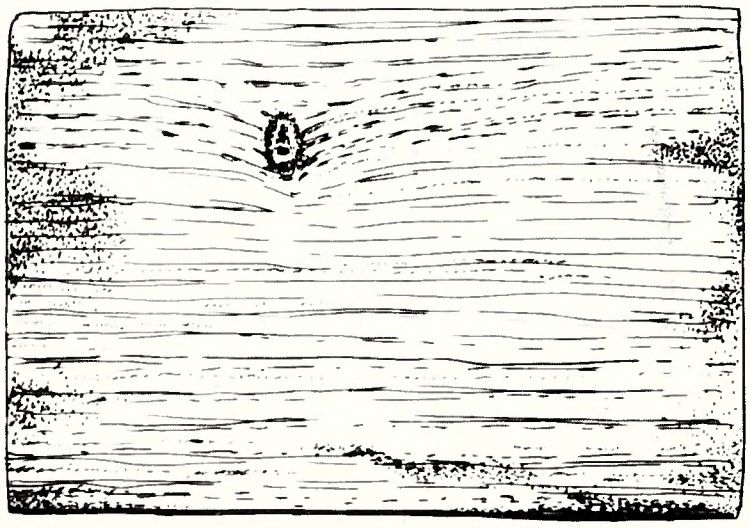
Condition: Good

Figure 96

Artifact: Wood fragment

Monitor: 071

Description: The sandalwood fragment measures 4 7/8 inches in length, 3 5/16 inches in width, and 1/4 inch in thickness. Saw marks on one of the finished sides have been almost removed by sanding or dressing and both ends and one finished edge contain small tack or wire nail holes.



Provenance: Test excavation level 4; area A *(Figure 109).*

Association: Officer's effects

Condition: Excellent

Artifact: Wood fragment

Monitor: 072

Description: The fragment of mahogany is 4 3/4 inches long, 1 1/2 inches maximum width, and 1 1/8 inches dressed thickness. One square nail hole survives in the funished surface.

Provenance: Test excavation level 4; area A *(Figure 109).*

Association: Joinery from officers' quarters

Condition: Good

Artifact: Wood fragment

Monitor: 073

Description: The fragment of fir is 5 1/2 inches long, 1 5/8 inches maximum width, and 3/4 inch maximum thickness.

Provenance: Test excavation level 4; area A *(Figure 109).*

Association: Joinery from officers' quarters

Condition: Good

Artifact: Wood fragment

Monitor: 074

Description: The fragment of pine is 6 1/4 inches long, 2 inches maximum width, and 1 inch dressed thickness. One finished surface contains two cut nail holes.

Provenance: Test excavation level 4; area A *(Figure 109).*

Association: Joinery from officers' quarters

Condition: Fair

Artifact: Wood fragment

Monitor: 075

Description: The fragment of pine is 2 3/4 inches long, 1 3/4 inches maximum width, and 3/8 inch thick. It has one wire nail hole lcoated 3/8 inch from the one remaining finished edge.

Provenance: Test excavation level 4; area A *(Figure 109).*

Association: Joinery from officers' quarters

Condition: Good

Artifact: Wood fragment

Monitor: 076

Description: The fragment of pine is 6 inches long, 1 inch maximum width, and 3/4 inch maximum thickness.

Provenance: Test excavation level 4; area A *(Figure 109).*

Association: Joinery from officers' quarters

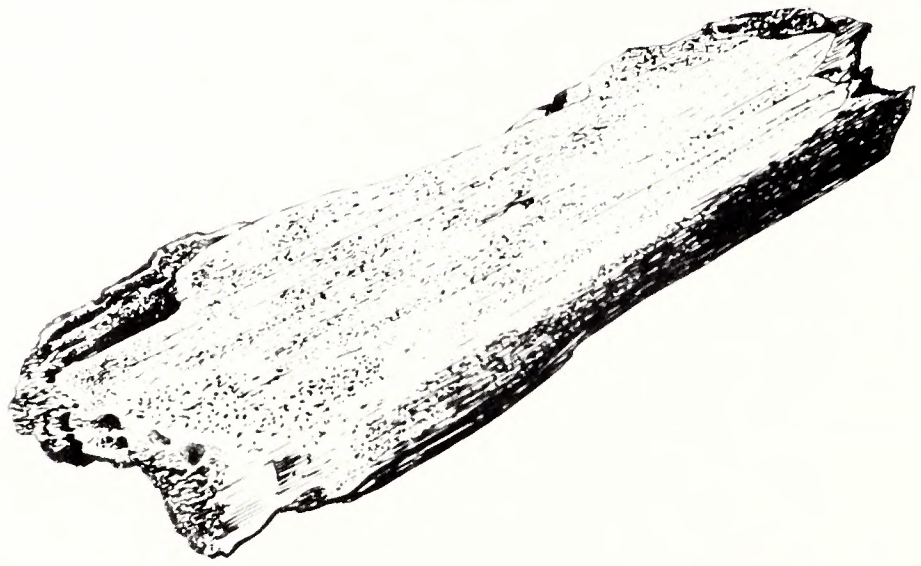
Condition: Poor

Figure 97

Artifact: Wood fragment

Monitor: 080

Description: The fragment of pine is 6 inches long, 2 inches maximum width, and 15/16 inch dressed thickness. The one remaining finished edge contains three randomly positioned nail holes.



MONITOR 080

Provenance: Test excavation level 4; area A *(Figure 109).*

Association: Joinery from officers' quarters

Condition: Good

Artifact: Wood fragment

Monitor: 081

Description: The fragment of pine is 4 1/2 inches long, 1 3/4 inches wide, and 1 inch maximum thickness. One remaining finished side preserves the remains of a cut nail hole.

Provenance: Test excavation level 4; area A *(Figure 109).*

Association: Joinery from officers' quarters

Condition: Poor

Artifact: Wood fragment

Monitor: 082

Description: The fragment of rough-cut pine is 4 inches long, 1 3/8 inches maximum width, and 1 1/8 inches rough-cut thickness. There is a square nail hole near one end with associated white paint or oakum residue.

Provenance: Test excavation level 4; area A *(Figure 109).*

Association: Joinery from officers' quarters

Condition: Good

Artifact: Wood fragment

Monitor: 083

Description: The fragment of mahogany or black walnut is 3 inches long, 1 1/4 inches wide, and 7/8 inch thick. It has a square nail hole in one surviving finished surface.

Provenance: Test excavation level 4; area A *(Figure 109).*

Association: Joinery from officers' quarters

Condition: Poor

Artifact: Wood fragment

Monitor: 084

Description: The fragment of pine is 4 1/2 inches long, 3/4 inch wide, and 3/8 inch thick.

Provenance: Test excavation level 4; area A *(Figure 109).*

Association: Joinery from officers' quarters

Condition: Good

Artifact: Wood fragment

Monitor: 085

Description: The fragment of pine tongue-and-groove paneling is 3 inches long, 1 3/8 inches maximum width, and 3/8 inch maximum thickness. One surviving finished end, cut on a 40-degree angle and a small portion of the tongue and a decorative bead associated with it remain intact.

Provenance: Test excavation level 4; area A *(Figure 109).*

Association: Joinery from officers' quarters

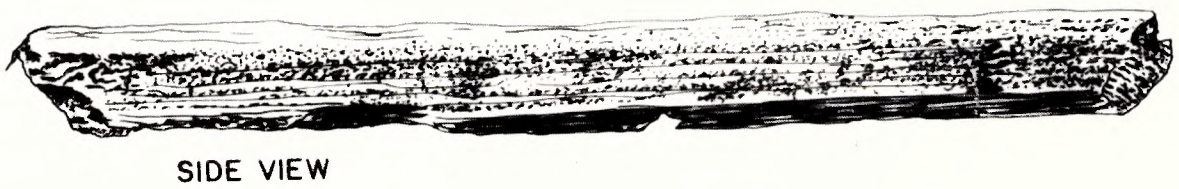
Condition: Poor

Figure 98

Artifact: Wood corner molding

Monitor: 087

Description: The pine corner molding is 16 1/2 inches long, 1 inch wide, and 7/8 inch thick. The surviving finished end of the molding has been cut on a 35-degree angle and the back of the molding has been cut lengthwise on a 45-degree angle to remove the hidden corner. Nail holes along the 1-inch finished face were driven on 5-inch and 6-inch centers and appear to have attached additional material.



Provenance: Test excavation level 4; area A *(Figure 109).*

Association: Joinery from officers' quarters

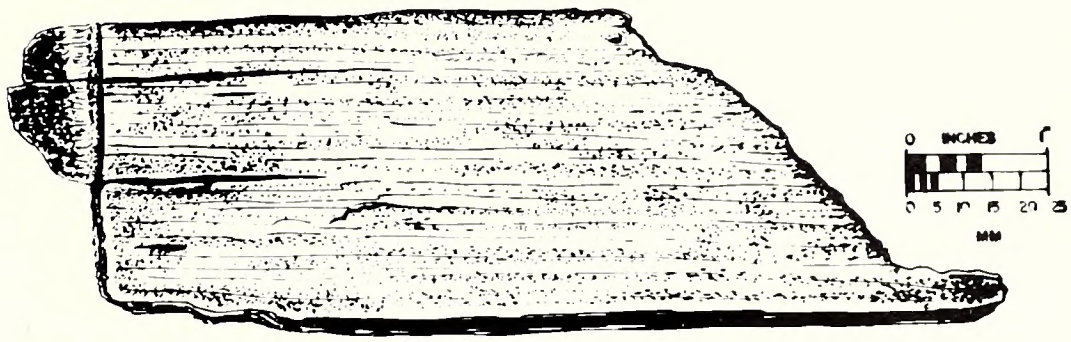
Condition: Good. Teredo damage

Figure 99

Artifact: Wood cask stave fragment

Monitor: 088

Description: The oak cast stave fragment is 7 1/8 inches long, 2 5/16 inches wide, and 5/16 inches thick. The surviving finished end has been beveled and notched to accept the base or head of the cask.



MONITOR 088

Provenance: Test excavation level 4; area A *(Figure 109).*

Association: Officers effects

Condition: Good

Artifact: Wood fragment

Monitor: 090

Description: Miscellaneous unidentified wood fragment.

Provenance: Test excavation level 4, area A *(Figure 109).*

Association: Unidentified

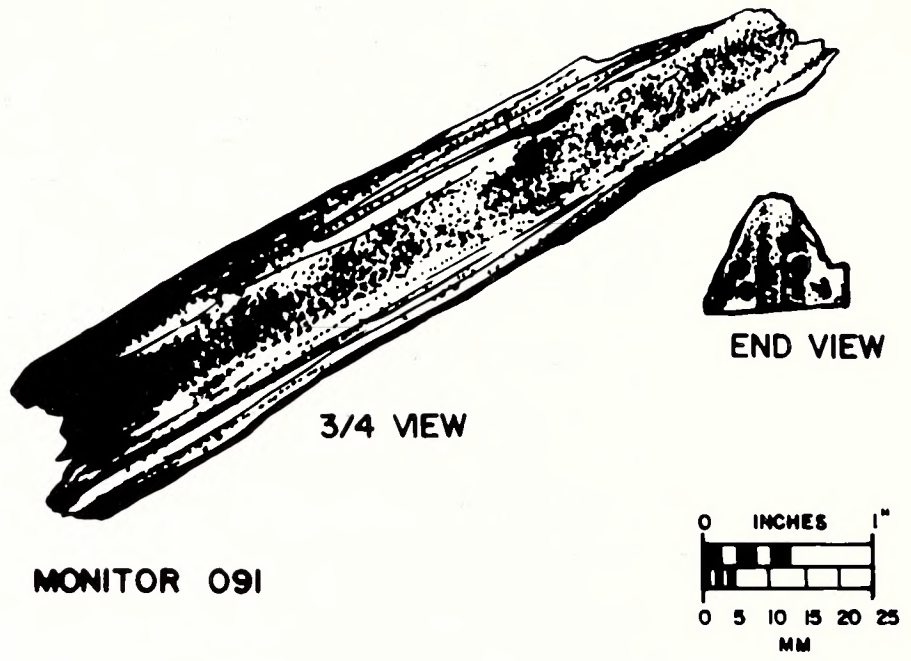
Condition: Poor

Figure 100

Artifact: Wood fragment

Monitor: 091

Description: The fragment of white pine corner molding is 5 1/4 inches long, 1 inch maximum width, and 7/8 inch maximum thickness.



Provenance: Test excavation level 4; area A *(Figure 109).*

Association: Joinery from officers' quarters

Condition: Good

Artifact: Wood fragment

Monitor: 092

Description: The fragment of clamshell molding is 3 inches long, 1 1/2 inches maximum width, and 9/16 inch maximum thickness.

Provenance: Test excavation level 4; area A *(Figure 109).*

Association: Joinery from officers' quarters

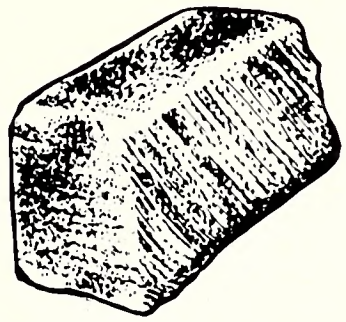
Condition: Good

Figure *101*

Artifact: Wood fragment

Monitor: 094

Description: The fragment of fir is 7/8 inch long, 1 9/16 inches wide, and 7/8 inch thick.



Provenance: Test excavation level 4; area A *(Figure 109).*

Association: Construction debris

Condition: Excellent

Artifact: Wood fragment

Monitor: 095

Description: The small fragment of mahogany is 2 7/8 inches long, 1/4 inch wide, and 3/8 inch thick.

Provenance: Test excavation level 4; area A *(Figure 109).*

Association: Construction debris

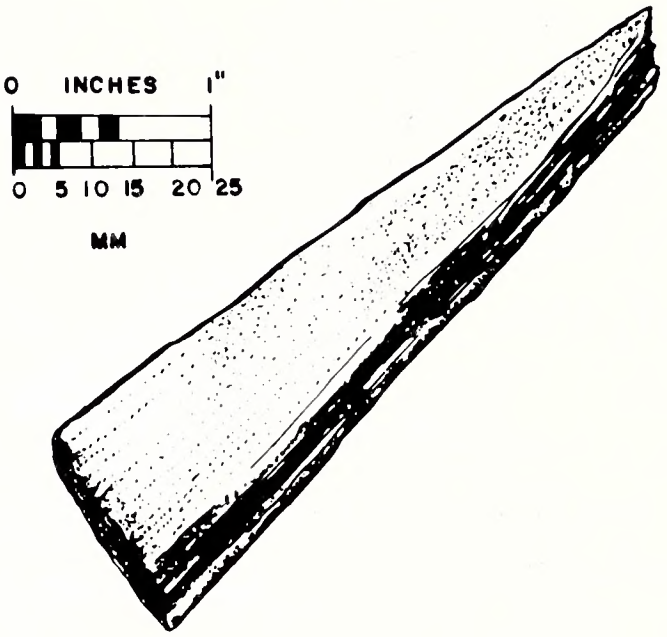
Condition: Good

Figure 102

Artifact: Wood fragment

Monitor: 096

Description: The fragment of pine is 3 7/8 inches long, 1 1/8 inches maximum width, and 1/2 inch thick.



MONITOR 096

Provenance: Test excavation level 4; area A *(Figure 109).*

Association: Joinery from officers' quarters

Condition: Excellent

Artifact: English walnut

Monitor: 010

Description: This is an intact English walnut.

Provenance: Test excavation level 4; area A *(Figure 109).*

Association: Officer's effects

Condition: Good

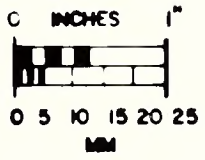
Figure *103*

Artifact: Leather book binding

Monitor: 014

Description: The leather book binding is 6 inches long by 4 inches wide. Two remaining finished edges have been folded over for a distance of 5/8 to 3/4 inch.

MONITOR 014



Provenance: Test excavation level 4; area A *(Figure 109).*

Association: Officer's issue material or effects

Condition: Poor

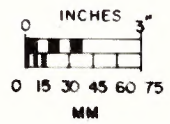
Figure 104

Artifact: Rubber hose sample

Monitor: 048

Description: The black rubber hose is 30 inches long, 1 1/2 inches in interior diameter, and has a 1/16-inch wall thickness. Fabric pattern on the exterior of the sample possibly represents impressions from the seamless molding process employed in manufacturing or impressions from a fabric exterior that has deteriorated. Collapsible configuration permits the hose to be rolled for storage. This sample is possibly modern.

MONITOR 048



Provenance: Surface sediment north of the port armor belt at datum casing 3; area E *(Figure 109).*

Association: Washdown system; possibly modern debris

Condition: Good

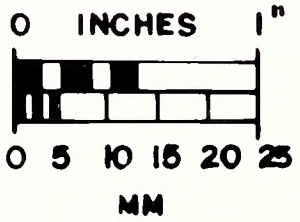
Figure 105

Artifact: Cork bung

Monitor: 055

Description: The cork bung is 1 3/8 inches in diameter and 5/16 inch thick.

MONITOR 055



Provenance: Test excavation level 4; area A, *(Figure 109).*

Association: Officer's effects

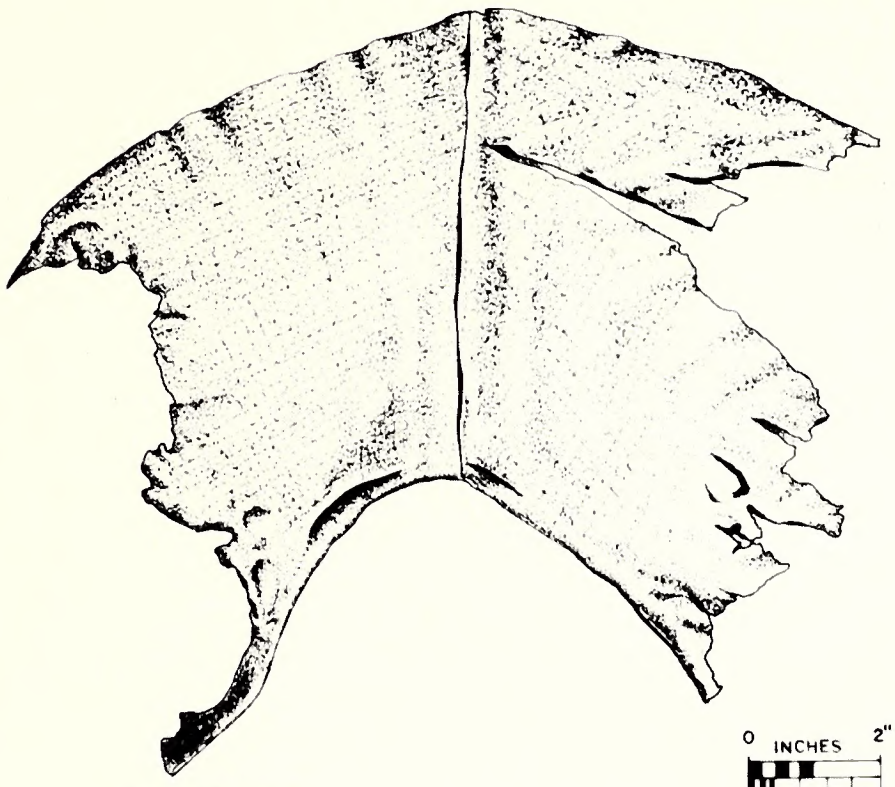
Condition: Excellent

Figure *106*

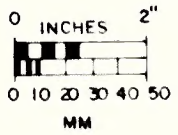
Artifact: Rubber-impregnated fabric fragment

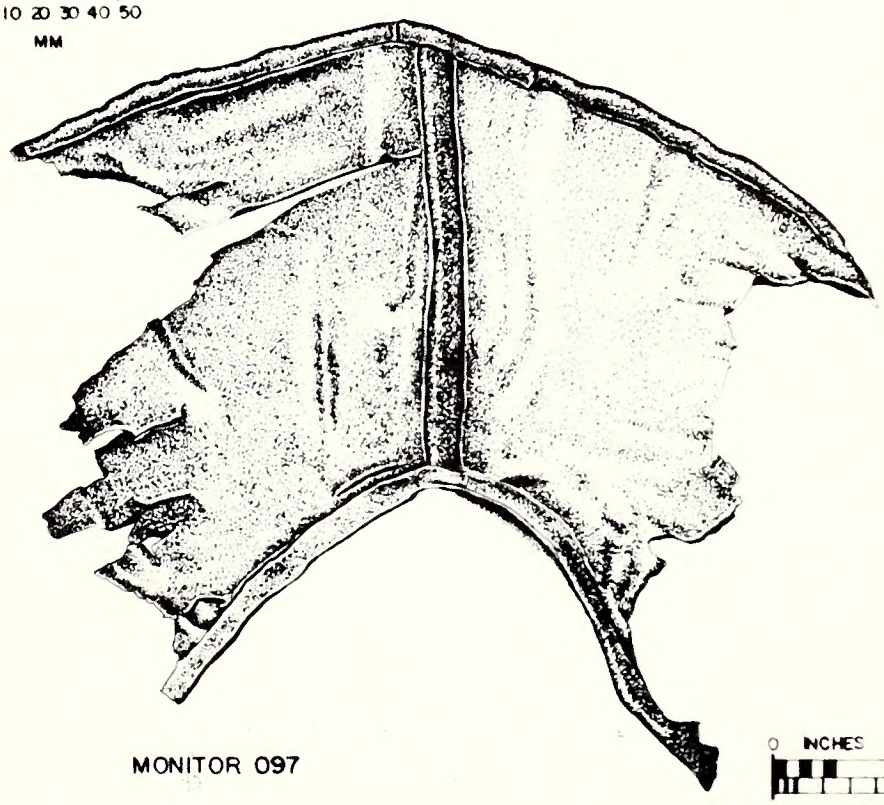
Monitor: 097

Description: The composite fragment of rubber-impregnated cloth is composed of two semicircular sections joined by a 9/16-inch lapped seam and bound on both the interior and exterior edges by reinforcing rubber tape.

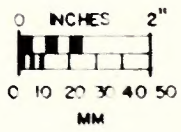


MONITOR 097





MONITOR 097



Provenance: Deck level test excavation; area A *(Figure 109).*

Association: Officer's issue materials. Perhaps the fragment represents a portion of the brim of a foul weather sou'wester cap exposed in the test excavation.

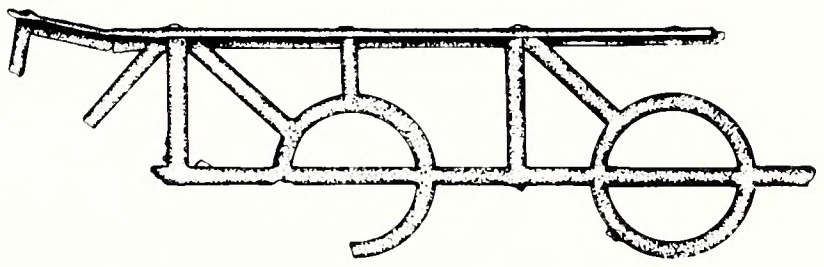
Condition: Good

Figure 107

Artifact: Plastic container fragment

Monitor: 003

Description: This is a modern plastic vegetable container fragment.



Provenance: Test excavation level 1; area A *(Figure 109).*

Association: Modern debris

Condition: Unpreserved

Artifact: Edgerton camera lens

Monitor: 042

Description: This EG&G oceanographic camera lens was lost at the site in 1973.

Provenance: Surface sediment inboard of port armor belt, forward of amidships bulkhead; area B *(Figure 109).*

Association: *Eastward* cruise 1973

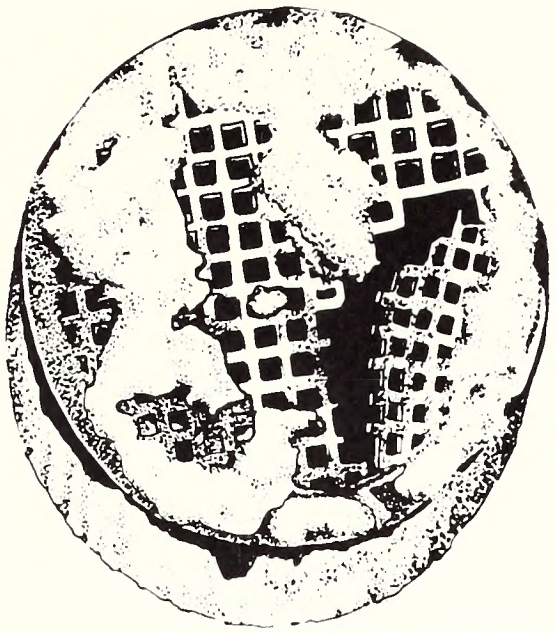
Condition: Good

Figure *108*

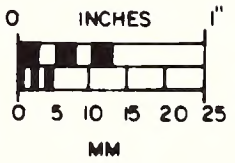
Artifact: Plastic strainer

Monitor: 100

Description: The modern plastic strainer is 3 1/2 inches in diameter.



MONITOR 100



Provenance: Test excavation level 1; area A *(Figure 109).*

Association: Modern debris

Condition: Unpreserved

ANALYSIS OF THE FINDINGS

Each phase of investigation in the *Monitor* National Marine Sanctuary generated new data concerning the condition of the wreck, the nature and scope of the archaeological record, and the environment. In addition to providing insight into a variety of historical questions, the data should prove to be of considerable value in formulating future plans for research and development of the site. For these reasons considerable attention has been devoted to the presentation of observations made during the 1979 operations.

Installation of the provenance stations that composed the nucleus of a permanent on-site reference grid provided insight into sediments along the north side of the wreck. Both the casing adjacent to the turret and that immediately aft of the amidships bulkhead were washed into the sediment to a depth of 5 feet without complication. Material flushed out of the casing was observed to consist of sand, shell hash, clay, sand stained by ferrous oxide, and another layer of shell hash. Bottom contours indicated that more than 4 feet of sediment had accumulated north of the turret and along the port armor belt. This was perhaps the result of the prevailing current that crossed the wreck from the south, depositing material both inside the wreckage and in its lee.

Depositional material decreased toward the bow, where scouring created by currents sweeping around the armor belt had created a trough. Both of the forward provenance casings could only be washed into the sand and shell hash sediment to a depth of 3 feet. At this level a stratum of extremely compact material associated with ferrous oxide-stained sand was encountered. All efforts to wash the casings through this layer proved fruitless.

In the course of positioning the baseline harness, washing the provenance casings into the sediment, and disturbing the sediment as a result of the submersible operations, numerous artifacts associated with the *Monitor* were observed. A wine or champagne bottle found in the surface sediment under the #3 casing, the decorated base of a gimbaled lantern found in association with unidentified concretions exposed by the submersible's bow thruster, a four-sided storage bottle washed up during the placement of the #3 casing, and miscellaneous concretions, sections of rubber-impregnated fabric hose, leather straps, and fragments of the vessel itself provided evidence of the presence of extensive amounts of material outside the confines of the hull remains *(Figure 109)*.

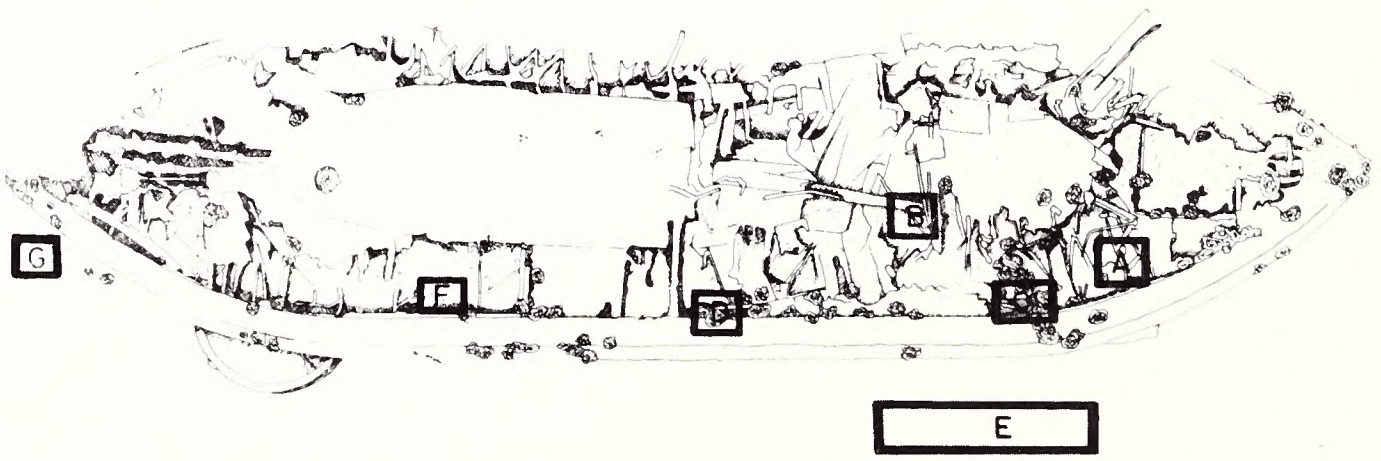


Figure 109. Artifact location chart.

Test excavations inside the confines of the remains of the *Monitor*'s hull produced additional data concerning the archaeological record preserved at the site and the physical condition of the wreck. While the investigation exposed a limited amount of the wreck, some interesting observations were made and a variety of material recovered. Both provided previously unavailable insight into the *Monitor*.

While on-site investigation of the area selected for the test excavation confirmed the absence of structural remains from the lower hull that would preclude carrying the excavation to deck timber,

subsurface structural features dictated that excavation of the lower levels be carried out in a restricted are *(Figure 65)*. Heavily concreted structural iron located along the north and east extremities of the test area precluded all but the most superficial investigation. As additional immovable material was uncovered, the scope of the excavation was reduced and reoriented toward the south and southwest. Only in the southwest corner of the test area was it possible to expose the underside of deck timber.

A thorough examination of the test area prior to excavation identified an intact octagonal glass jar embossed "MUSTARD" on one side and "U.S. NAVY" on the reverse. Although left *in situ* while the first 6-inch layer of sediment was removed it was obvious that its association with the *Monitor* had been disturbed. This was later confirmed by the discovery of part of a modern plastic strainer in the sediment below the bottle. Excavation of the second and third 6-inch layers of sediment produced additional modern plastic debris representing not an intrusion but the high energy nature of the upper stratum of bottom sediments. This high energy nature was confirmed by the amount of sediment that was found redeposited in the excavation during several brief periods when activities at the site were suspended *(Figure 110)*.

The sand and shell hash compositions of this upper stratum of sediment differed distinctly from the stratum of mixed sand and clay found 14 inches to 16 inches below the sediment surface. Varying in thickness from 3 inches to 5 inches, this stratum was clearly distinguishable from the sand and shell hash above it. While neither modern debris nor artifacts associated with the *Monitor* were found at this level, numerous small concreted fragments of lower hull structure were present. It is possible that this stratum is associated with the destruction of the *Monitor*'s lower hull. Concreted material indicated that the ship had accumulated an extensive calcarious crust before the hull collapsed.

Below this second stratum sediment was found to consist of a fine silt and occasional clam shells. Although lower hull plate and frame fragments associated with features of the lower hull were present in this layer, none of the small separate concretions was found. Perhaps this layer accumulated as waterborne organic material and light sediment filled the hull prior to collapse *(Figure 111)*.

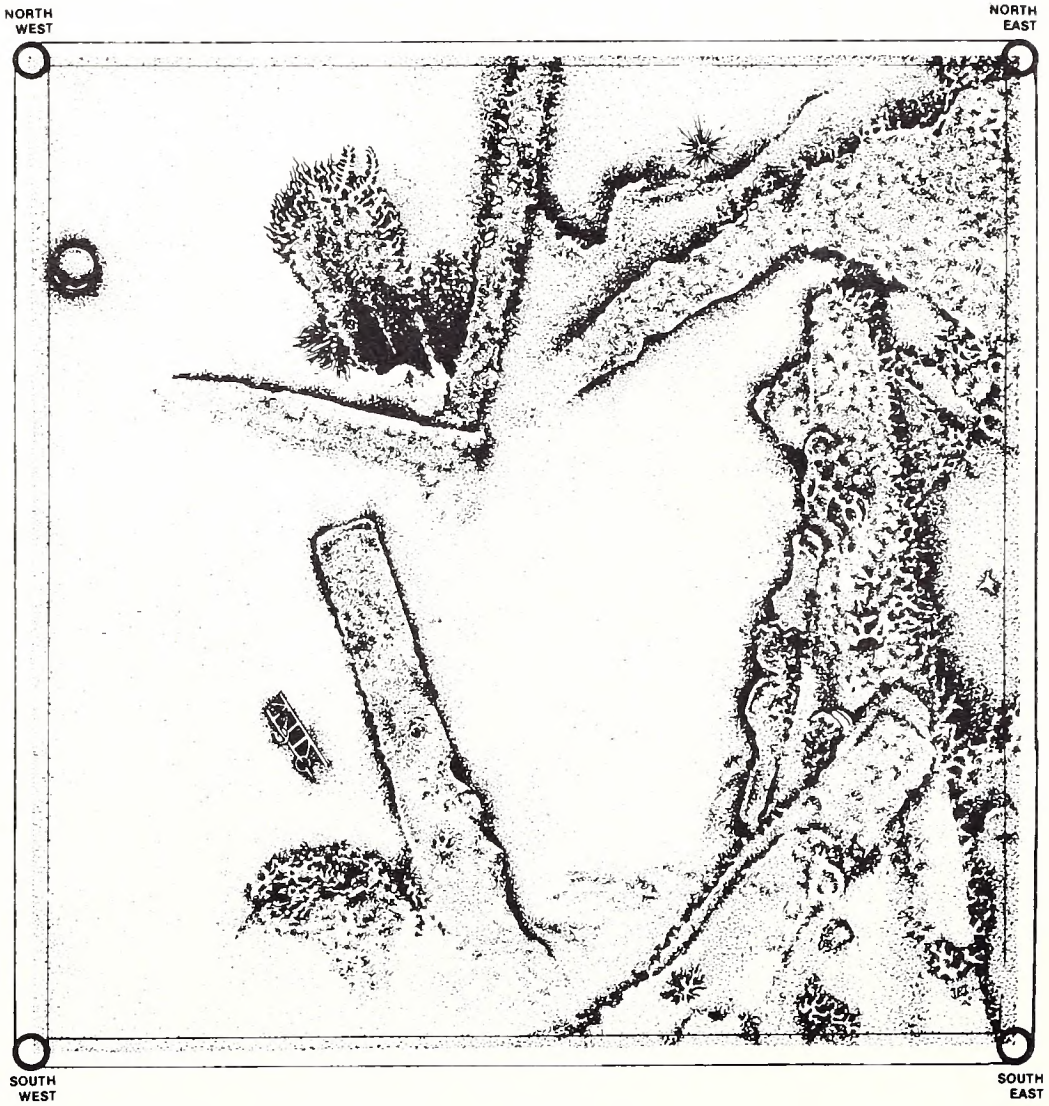
As the excavation of this third and final stratum approached deck beams and planking, extensive material from interior nonstructural bulkheads, cabinetry, and furnishings was recovered. This material and artifacts associated with the *Monitor* were found to have accumulated against the forward face of athwartships deck beams. Although certainly not conclusive, this peculiar accumulation could have resulted as the *Monitor* rolled over and settled by the stern after filling with water.

Artifacts produced by the test excavation reflected personal possessions and perhaps issue materials of the vessel's captain. Available historical source materials indicated that this area of the ship served as the captain's cabin. While the foul-weather gear may have represented service-issued personal effects, the leather book binding and soap dish quite likely represented material that comprised a portion of the ship's service and library. The remains of the English walnuts and staves from a small cask must have been acquisitions secured and owned personally by Captain Bankhead himself *(Figure 112)*.

Deck beams and planking exposed by the test excavation were found to retain all of their original surface detail. While time did not permit the removal of samples of the wood for analysis, probing indicated that neither cellular deterioration nor teredo or pholad damage had substantially weakened the deck beams or the deck planking below the sediment surface. As was indicated in surviving historical source materials, the beams appeared to be oak while the planking appeared to be pine. Fragments of nonstructural wood bulkheads, cabinetry, and storage containers all exhibited extensive teredo and pholad damage *(Figure 93)*.

Exploration of the remainder of the *Monitor* produced additional observations. While the majority of these were related to the present condition of the remains of the *Monitor*, others concerned details of historical and architectural significance. All of these observations should prove to be of some value in formulating and evaluating future plans for on-site research or development.

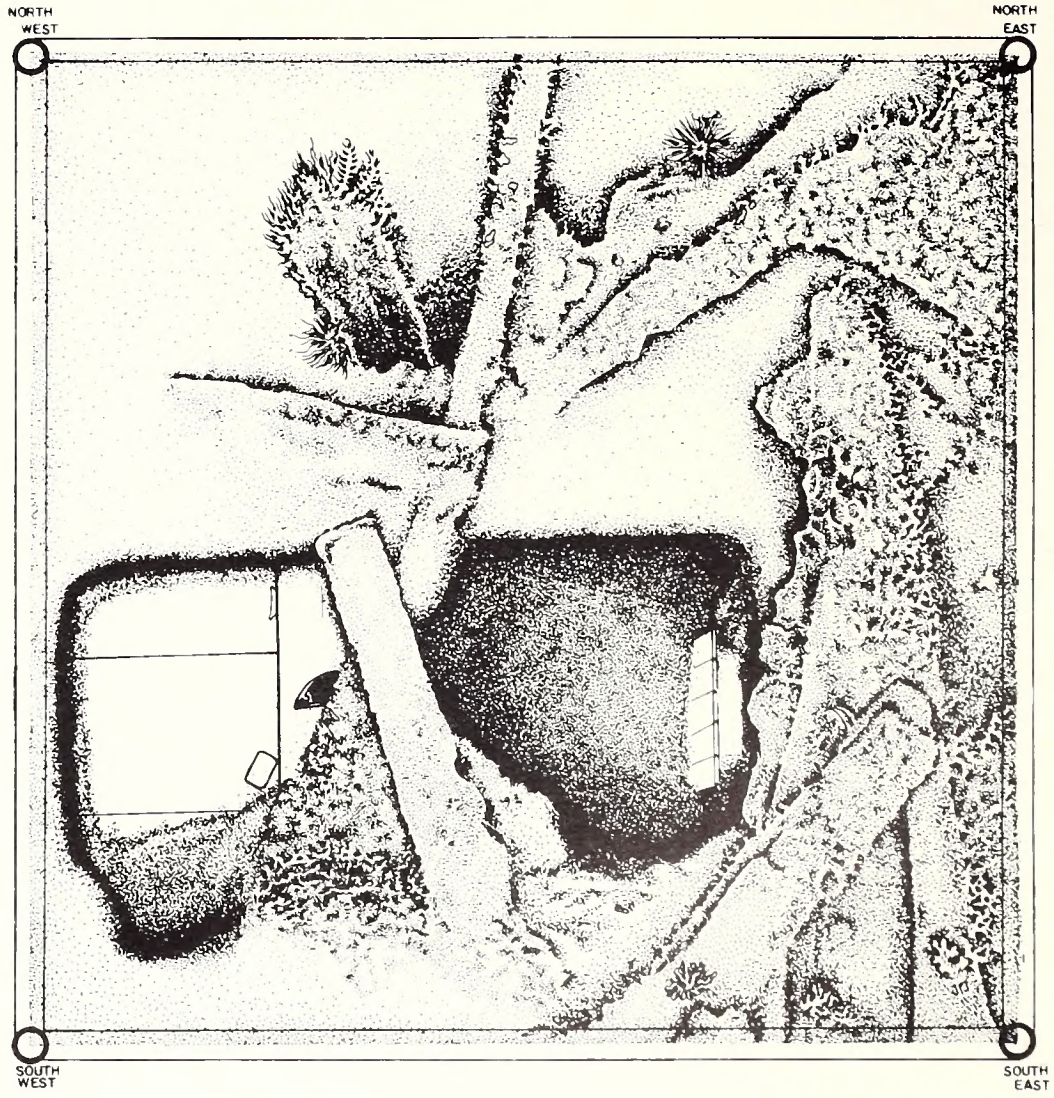
LEVEL 1



LEVEL 2

Figure 110. Test excavation levels 1 through 4.

LEVEL 3



LEVEL 4

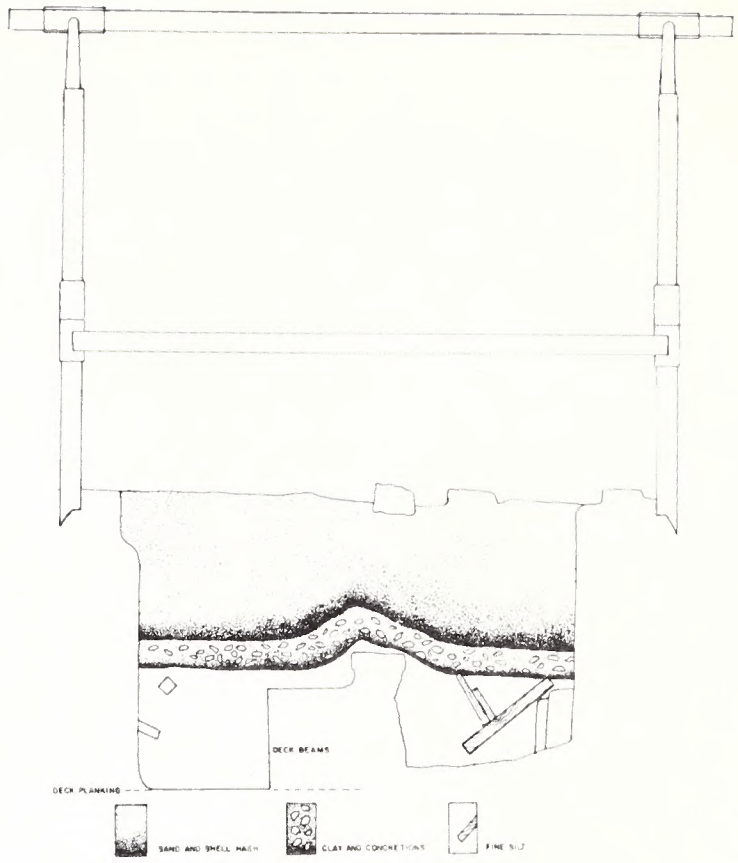


Figure 111. South profile of test excavation.

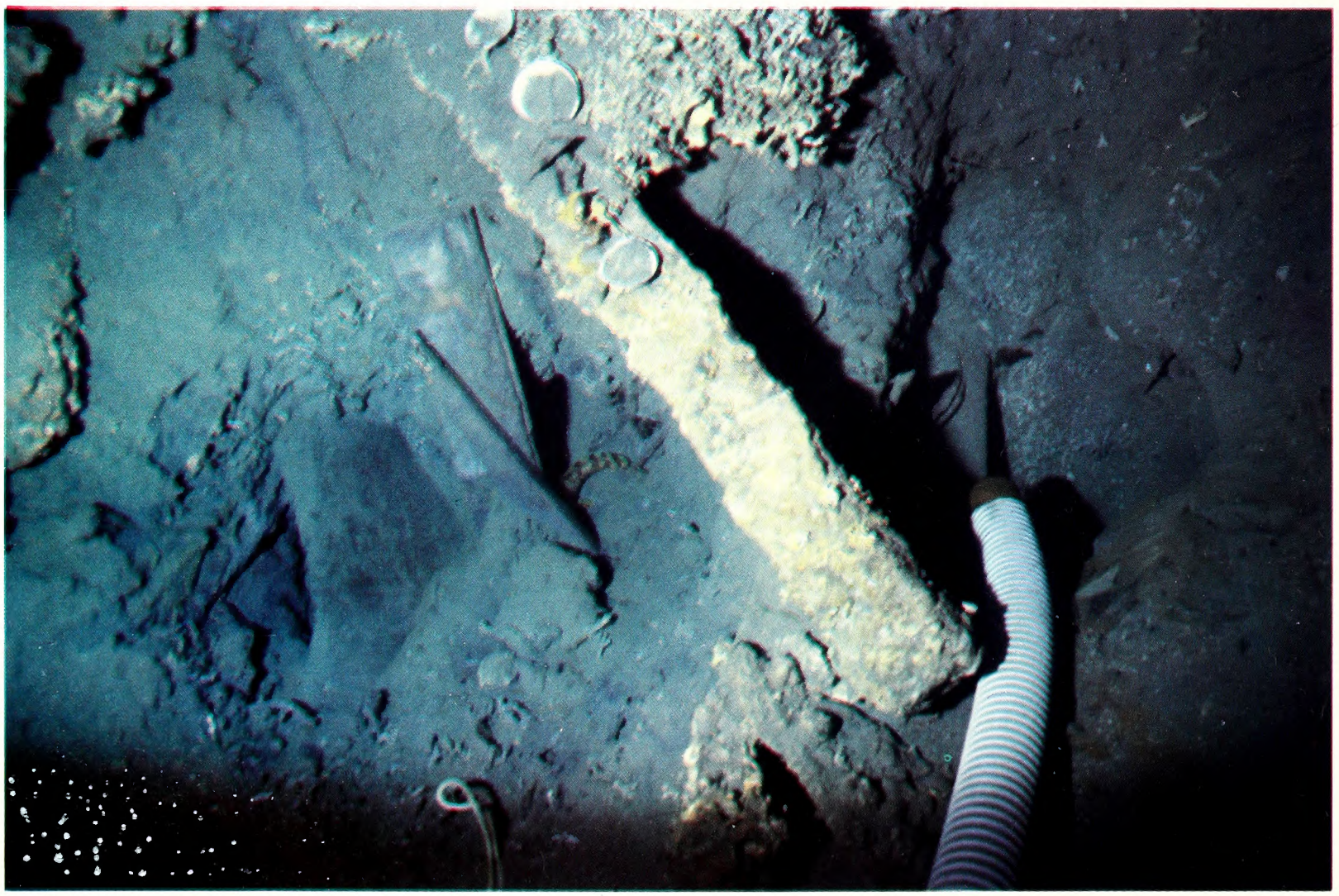


Figure 112. Although restricted by structural material from the collapsed lower hull of the Monitor, excavation at the test site was carried to a depth of 4 feet and exposed portions of the vessel's deck beams and planking. On the left of an iron frame dividing the south half of the test pit, the remains of a tongue-and-groove pine bulkhead were identified and recovered. To the right of the diagonal frame and directly underneath the nozzle of a 2 1/2 inch induction dredge used to remove sediment from the test, one of the ship's deck beams can be seen. Lying on the beam beneath the shadow of a wood fragment are the well-preserved remains of a leather-brimmed, rubber-impregnated canvas sou'wester hat. Because the foul weather gear was secured to an iron bolt in the deck by corrosion, the decision was made to leave it ***in situ.***

Immediately aft of the bow and forward of the circular anchor well, the deck was fitted with a closed iron chock approximately 3 feet in width and 18 inches in height. Although heavily fouled, its trapezoidal configuration was apparent. A depression in the fouling covering the deck aft of the chock suggested the possibility that it was constructed to recline into a recession in the deck during combat. Pad eyes mounted on the port armor belt adjacent to the pilot house and forward of the present location of the turret were designed to operate in this manner, confirming that the concept was employed by Ericsson *(Figure 113)*. Each of the triangular pad eyes was designed to recline into a recess in the deck.

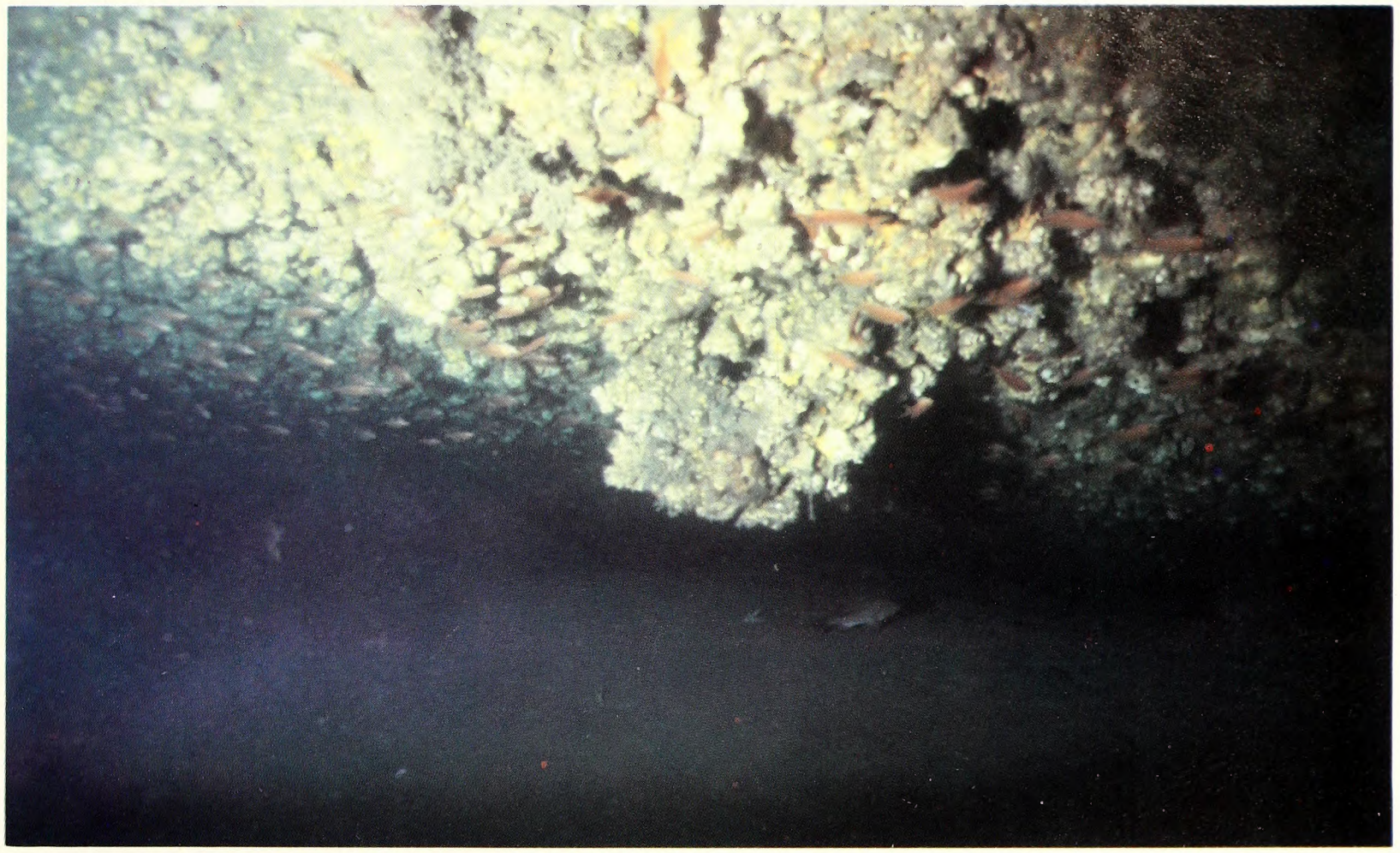


Figure 113. A heavily-fouled pad eye was located inboard of the armor belt on the port side. Also visible in the background of the photograph is the base of the armored pilot house.

Aft of the anchor well the base of an iron pyramid constructed to protect the pilot house was visible. Immediately aft of the pilot house structure deck armor was observed to have been reinforced by additional armor plates that appeared to measure approximately 4 feet by 10 feet. These reinforcing plates were placed athwartships and appeared to be approximately 1-inch in thickness.

Inside the confines of the hull in the vicinity of the test excavation the exposed end of an iron floor timber was examined and measured. The beam, constructed of 1/2-inch to 5/8-inch plate reinforced at the top and bottom by 2 1/2-inch or 3-inch angle iron, proved to be 18 inches in width. The angle iron reinforcing the bottom was attached to lower hull plating with flush head rivets peened inside the hull. Port of the center line of the vessel and aft of the pilot house structure, a 3-inch-diameter pipe equipped with a through-the-hull flange protruded from the sediment. While additional investigation would be required to substantiate such an identification, it could quite possibly be the remains of a unique depth sounding device that Ericsson had designed for the *Monitor*.

Examination in the area of the wardroom identified one of two substantial ruptures in the deck forward of the amidships bulkhead *(Figure 114)*. Located on the center line of the hull and possibly associated with a hatch that penetrated the deck, the damage was observed to affect an area of approximately 50 square feet. A close examination of the exposed deck beams and planking indicated that teredo damage was extensive on the surface. While a brassframed deck light was found in excellent condition, electrolytic reduction had done extensive damage to iron deck armor plate in its vicinity. In the area adjacent to the damaged area extensive amounts of lower hull plate, framing, what appeared to be the remains of a radiator, and a variety of artifacts were observed. These included fragments of ceramics, leather fragments of shoes, broken glassware, and unidentifiable concretions. A sample of ironstone ceramics and an intact glass storage jar, with "Hartell's Glass Air-Tight Cover, Patented Oct. 19, 1858" stamped on the lid, were removed for analysis and preservation. The glass jar *(Figure 115)* was found to be air tight and the contents, relish, were exceptionally well preserved.

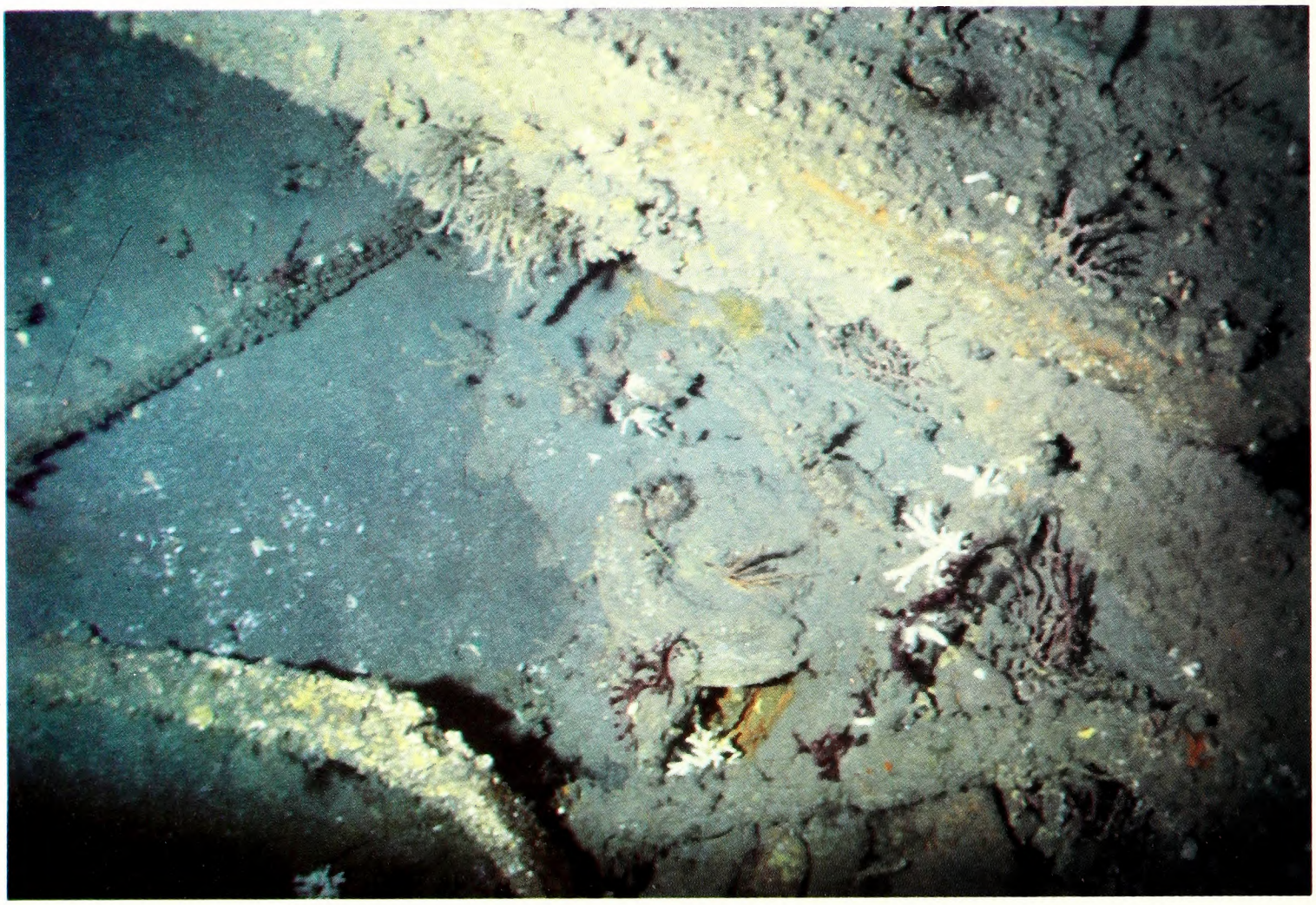


Figure 114. To the right of center, a brass-mounted glass deck light penetrates the deck of the **Monitor** *adjacent to one of several holes in the armored "raft."*

Immediately forward of the amidships bulkhead and inboard of the port armor belt, a second and larger rupture in the deck was identified *(Figure 116)*. There damage was observed to have affected approximately 70 square feet of the deck structure. Again exposed deck beams and planking evidenced extensive teredo and pholad damage. Material from deteriorated storage cabinets adjacent to the armor belt, portions of the amidships bulkhead plating, remains of cabinetry, and a copper bucket were observed, and numerous unidentified concretions were observed in the damaged area and on the sand immediately below. Adjacent to the damaged area, armor plates on the deck were found to have separated from the wood deck structure.

Figure 115. A Hartell's Glass jar containing relish, the lid and seal intact, was recovered from the north side of the wreck in the vicinity of the wardroom.

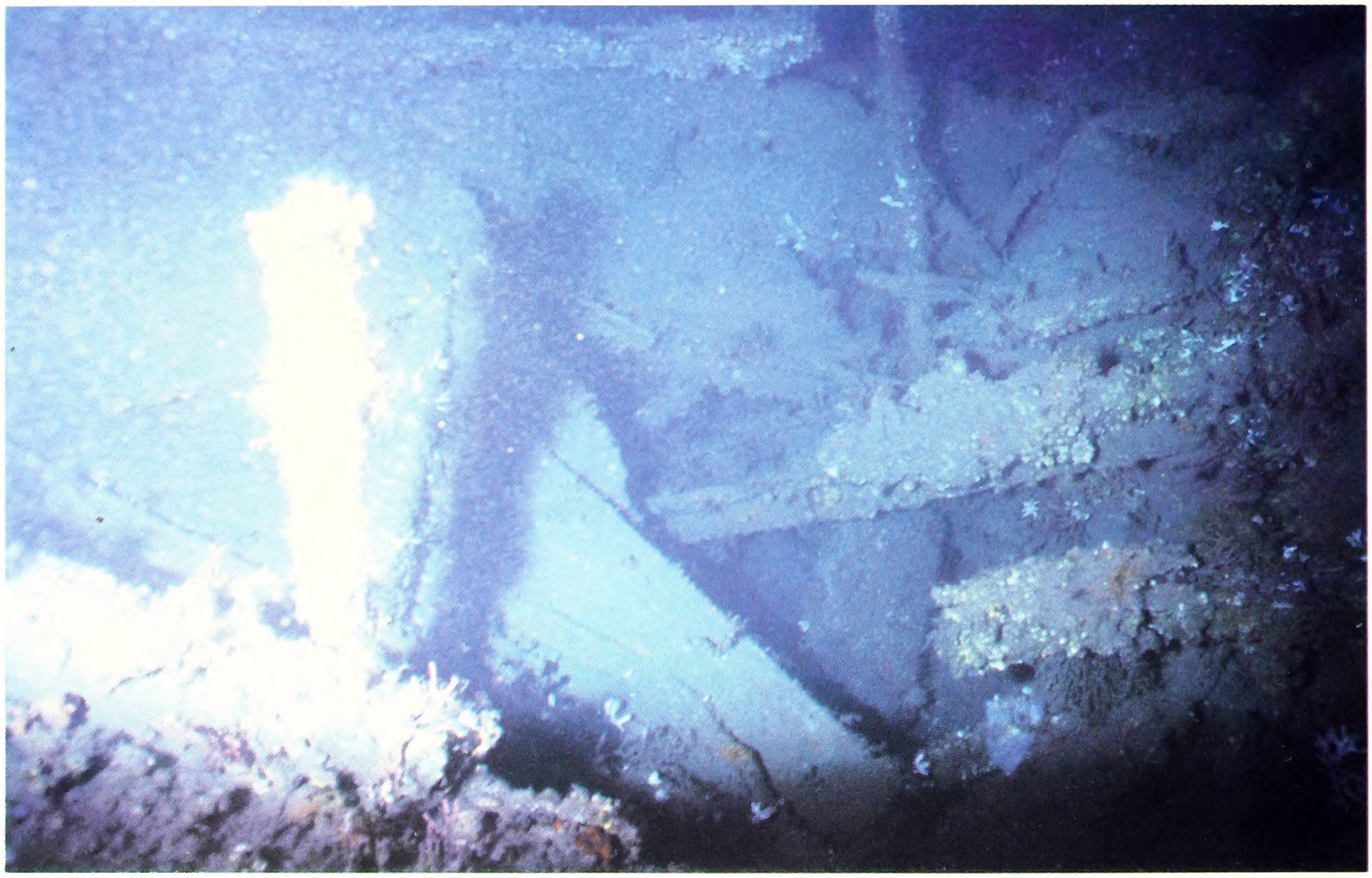
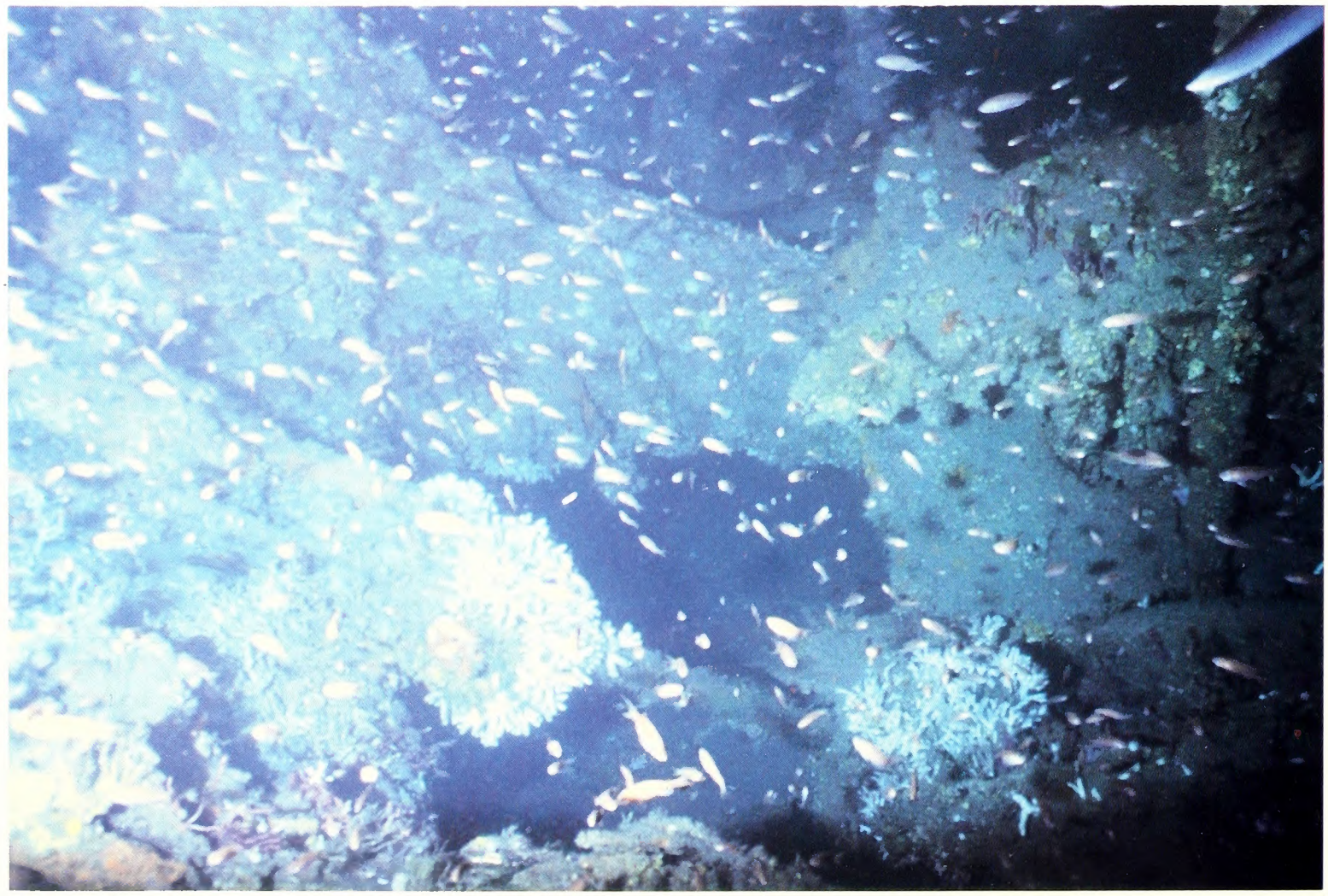


Figure 116. Immediately inboard of the port armor belt and forward of the amidships bulkhead, damage to the armored "raft" has left a substantial hole in the deck structure.



Adjacent to the deck-related damage, the amidships bulkhead was found to have deteriorated completely to a point on the vessel's center line where a heavy yoke was positioned to support the turret shaft *(Figure 117)*. The frame for the port water tight door that provided access to the engineering space and galley was found resting on the remains of a large centrifugal pump or blower mounted to the overhead forward of the port boiler *(Figure 118)*. Aft of the turret support yoke, remains of the iron galley stove were identified. Starboard of the turret support yoke, the amidships bulkhead was still intact although portions of the plating had deteriorated. A wedge designed to raise the turret for rotation was found intact on the yoke and an examination of the bottom plating on the lower hull adjacent to the yoke confirmed that plates along the center line of the vessel had been formed to create a false keel *(Figure 119)*.

Both port and starboard boilers were found to be intact and in excellent condition *(Figure 120)*. Although they appeared to have separated from the foundations, rupturing some of the piping, no evidence of forward or aft movement was apparent. Inspection plates, firebox doors, and access to ash pits were all found open, making an examination of the fire tubes possible *(Figure 121)*. The uptake on the after-end of the port boiler was found to be partially detached as a result of shifting of the structure. Inboard of both the port and starboard armor belts coal from deteriorated bunkers located adjacent to the boilers was found to obstruct passage from the galley to the engineering space aft of the boilers *(Figure 122)*.

Machinery located in the after extremity of the lower hull was found in an excellent state of preservation, although obscured by fouling organisms. The lower portions of Ericsson's complex vibrating-lever engine were visible above the sediment that had accumulated on the overhead *(Figure 123)*. The remains of the governor and water condenser or freshwater distillation plant could be identified on the port side. The serpentine-spoked wheel that changed the relationship of valves in the main steam chest to provide forward and reverse was clearly visible forward of the engines *(Figure 124)*. On the starboard side of the engine a stairway with five steps was found *(Figure 125)*. Aft of the stairway and adjacent to the armor belt on both the port and starboard side of the engineering space donkey engines and associated pumps or blowers were identified *(Figure 126)*. A sample of coal from the port bunker was removed for analysis.

Aft of the lower hull damage to the armor belt and deck was confirmed to be severe. Distortion of the deck caused by the present location of the turret, possible damage during the sinking, and deterioration had left the port armor belt more than 10 feet off the bottom while less than 2 feet of the starboard armor belt was exposed above the bottom. Examination of the interior of both the starboard and port armor belts at the stern confirmed extensive teredo or pholad damage and excessive cellular deterioration *(Figure 127)*. At both locations bolts and pins that attached armor to the wood substructure were clearly visible. Most of the deck between the armor belt structures had collapsed and was found to rest partially submerged in the bottom sediment. The "Y"-shaped yoke that supported the after-end of the skeg and propeller shaft had dislodged from its bearing in the support yoke but was supported by the propeller. Each of its four blades was found intact *(Figure 128)*.

In the vicinity of the turret deck plates were found to have been dislodged by destruction associated with the stern of the vessel. Behind the turret the deck was, in fact, found to have completely separated and armor plates hung suspended by deteriorated fittings *(Figure 129)*. Forward of the turret deck armor plates were generally in their original position and disturbance was slight. Below the position of the port boiler the uptake was found protruding from the deck and into the sediment.

Structurally the remains of the turret were found in excellent condition. The gun ports remained closed by heavy wrought iron pendulums that protected the ordnance and gun crews from hostile fire and that were dogged in position except while the vessel was in combat *(Figure 129)*. Wood bucklers that covered the gun ports while underway were not located, although bolts that held them in place were observed intact protruding from holes in the pendulums. Aside from basketball-size dents still visible through the heavy fouling, little damage was apparent. Probing the turret floor with a 3-foot compressed gas probe indicated that the wood floor of the structure had deteriorated but remained intact under a layer of sediment and coral. Examination of the structure produced no indication of access hatches in the base. A depression in the center of the turret floor indicated that the shaft upon which the turret rotated had dislodged as the turret and hull separated.

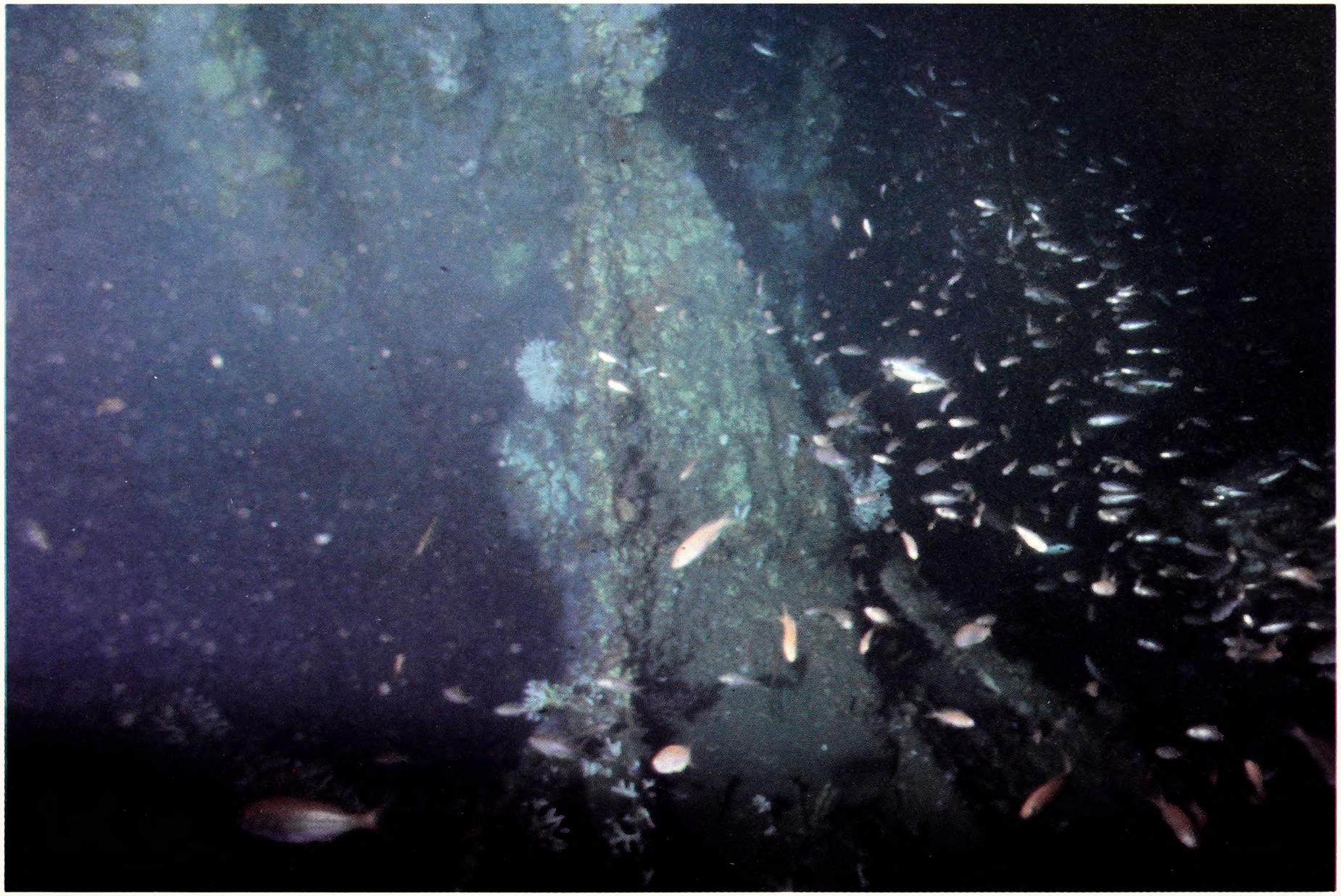


Figure 117. A reinforcing yoke attached to the amidships bulkhead served to reinforce the hull and support the turret. A wedge, located at the bottom of the photograph, "keyed" the turret up to permit rotation and training of the guns. To the left and aft of the yoke the remains of the galley stove were identified.

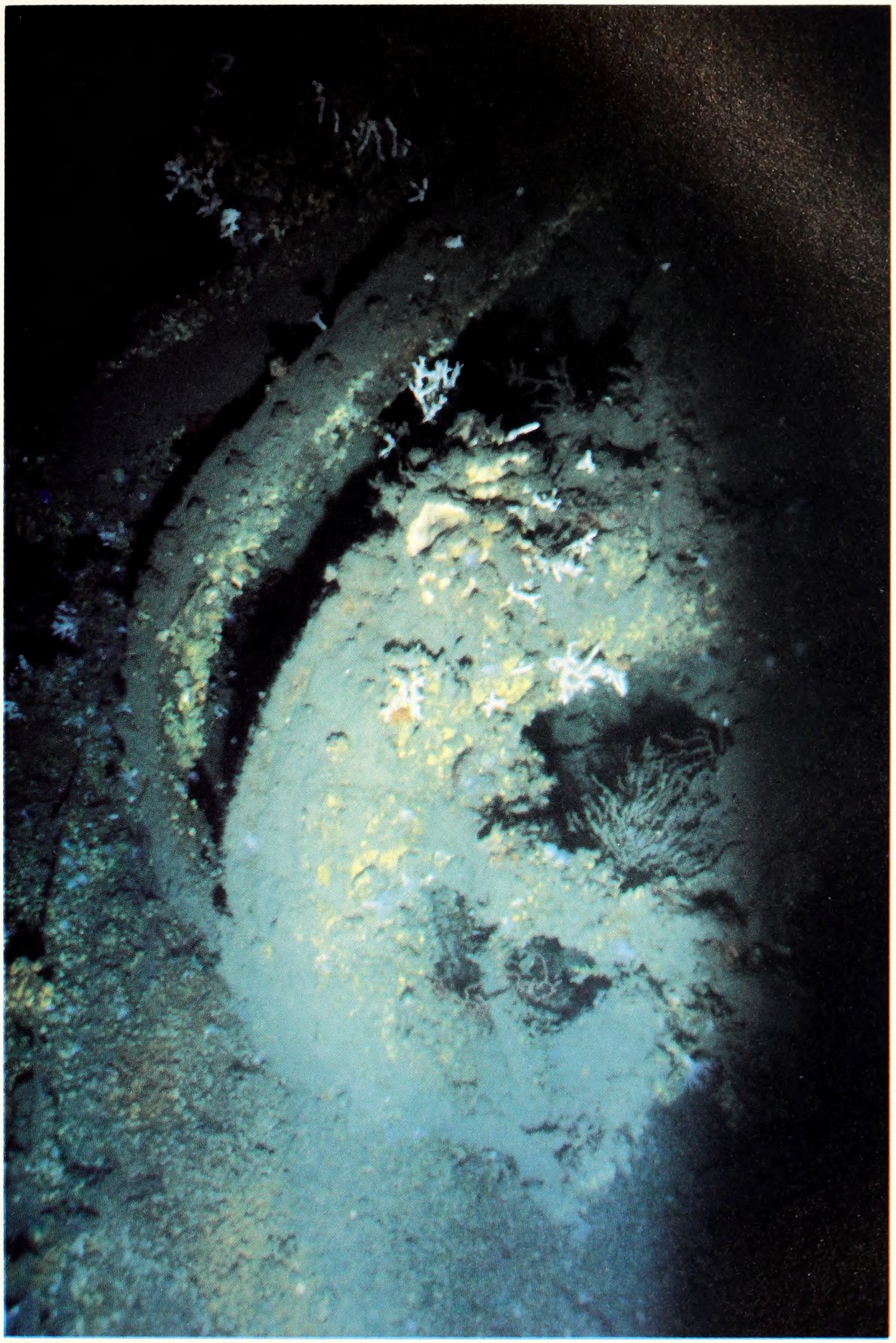


Figure 118. The remains of a centrifugal pump lie immediately forward of the port boiler. Framing for the port airtight amidships bulkhead door lies to the right of the pump.

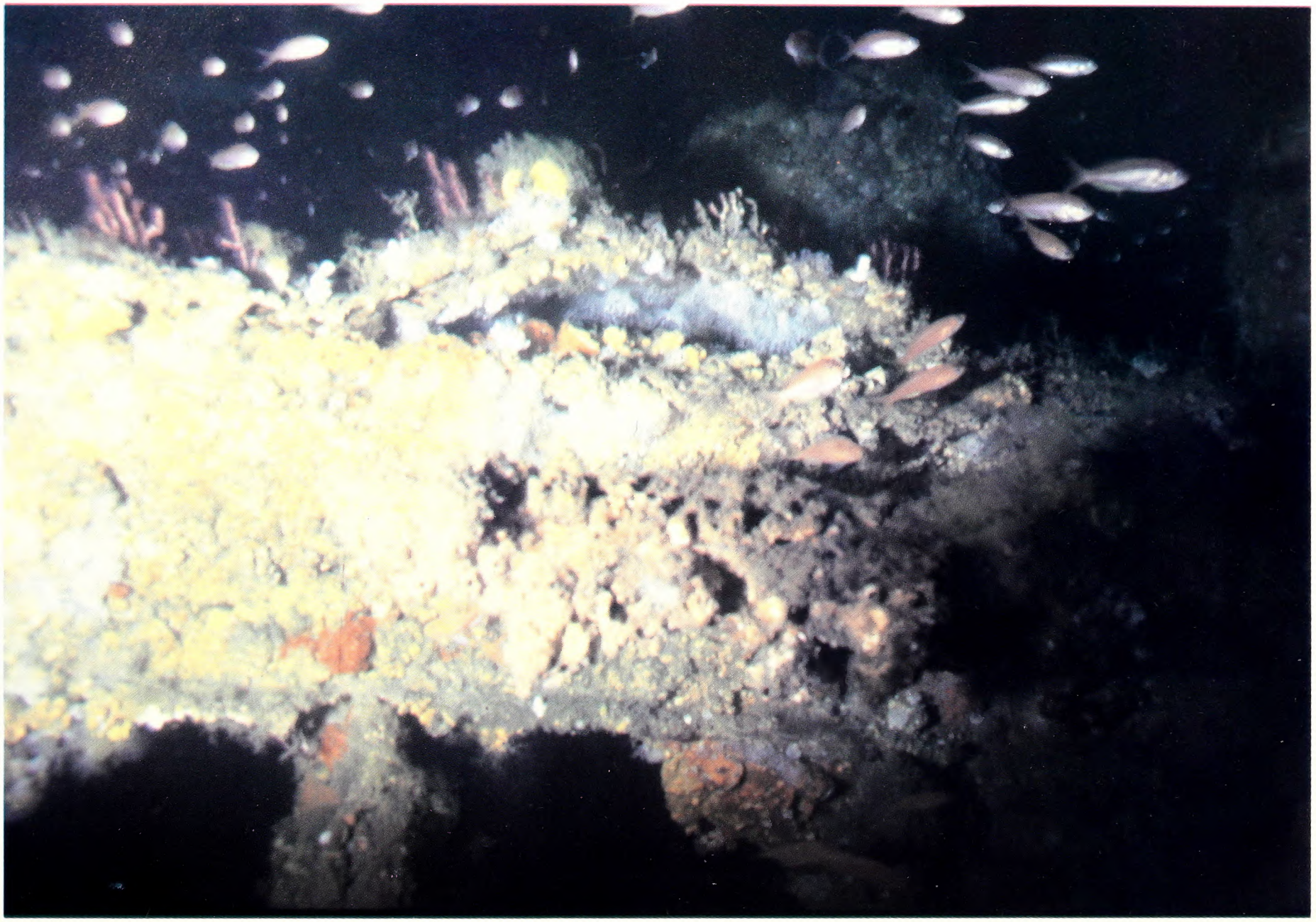


Figure 119. The **Monitor***'s false keel, formed from contoured sheet iron, provided a water course below the floors along the longitudinal axis of the vessel. The false keel, photographed at the amidships bulkhead looking aft, provided the only features on the otherwise flat bottom of the vessel.*

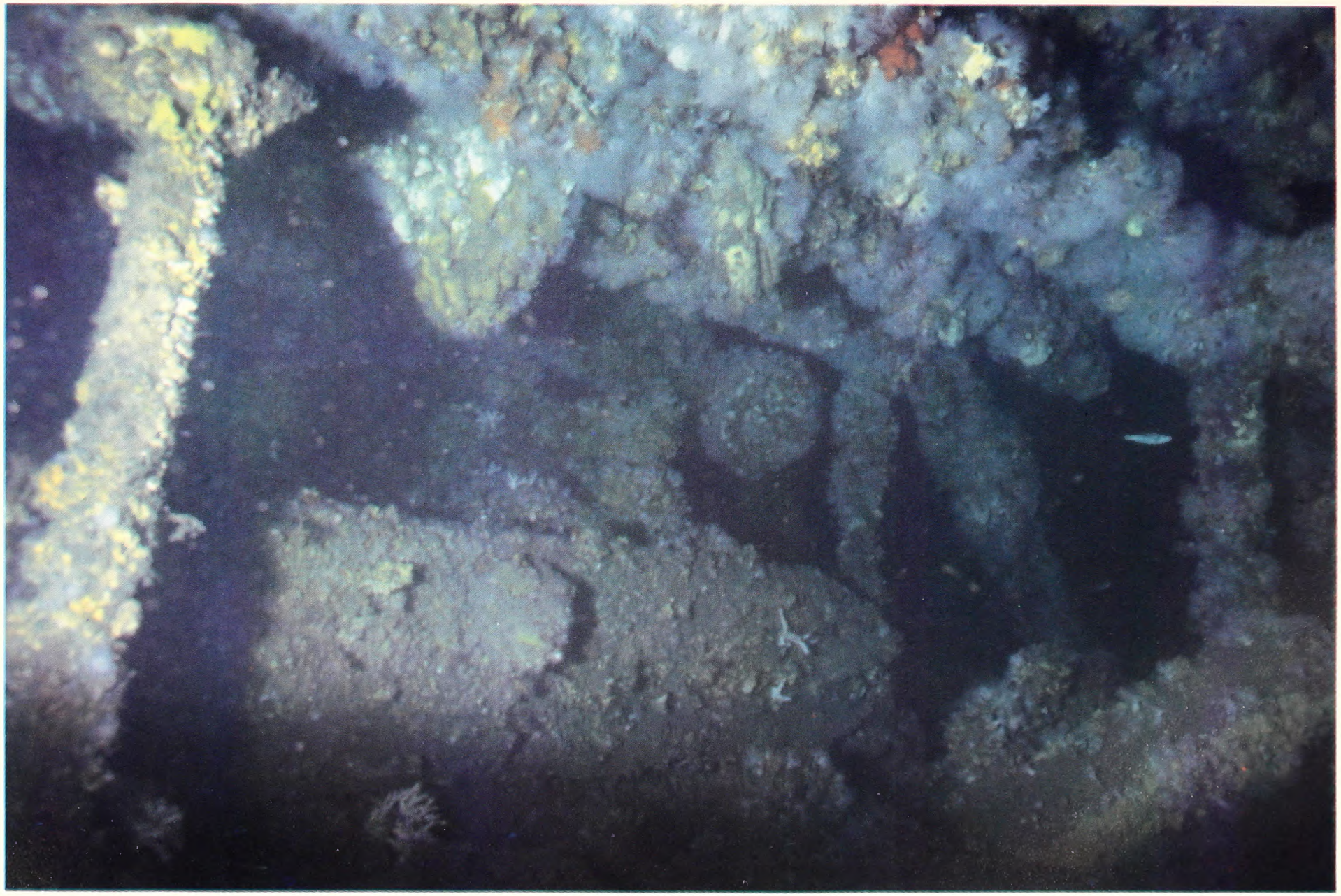


Figure 120. Looking aft from the galley over the bottom of the starboard boiler, heavily-fouled floors at the top of the photograph remain secured to stanchions visible at the right.

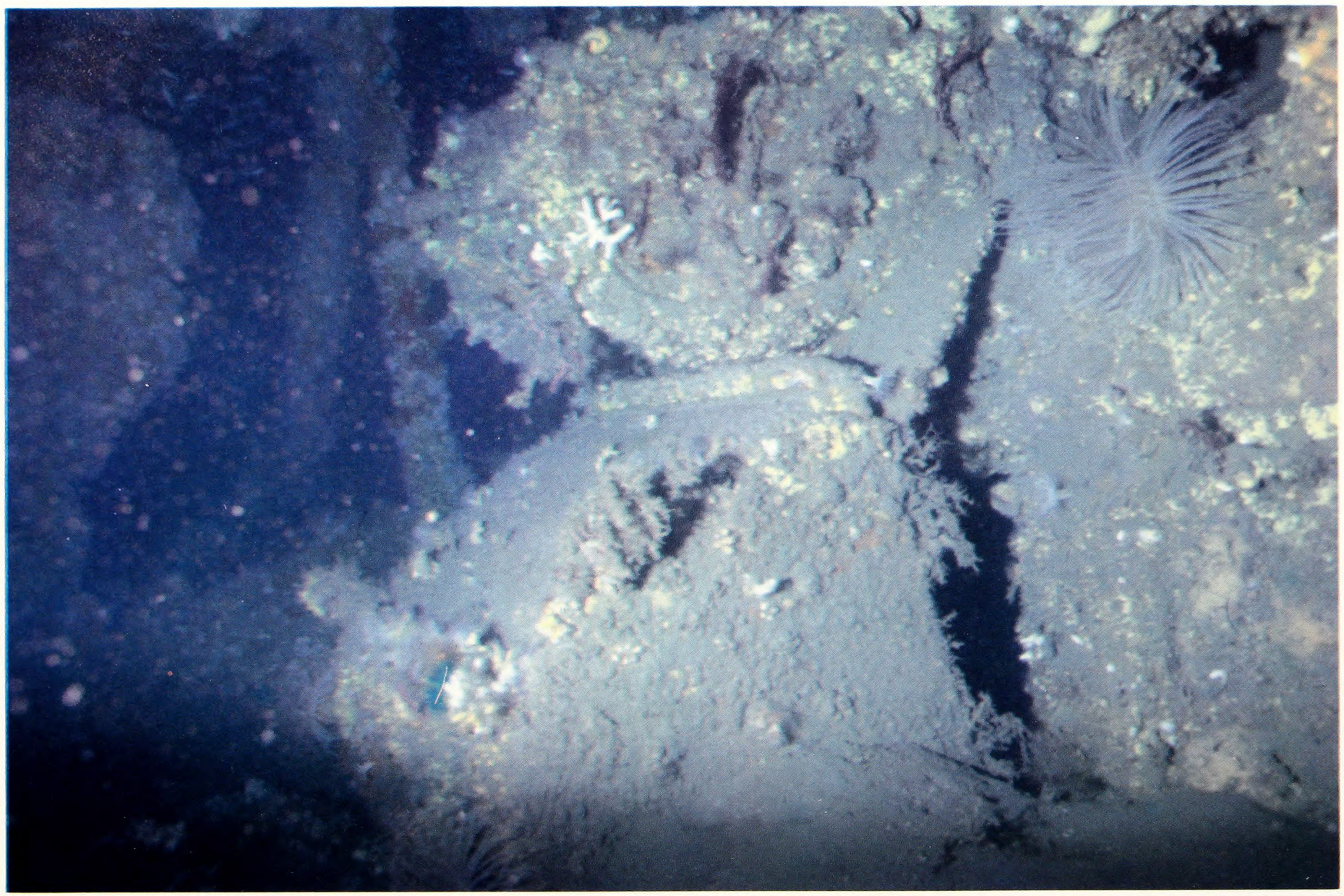


Figure 121. The starboard boiler exhaust uptake rests approximately in its original position, although no longer attached to the afterface of the boiler. Above the duct an encrusted furnace door hangs from its hinges.

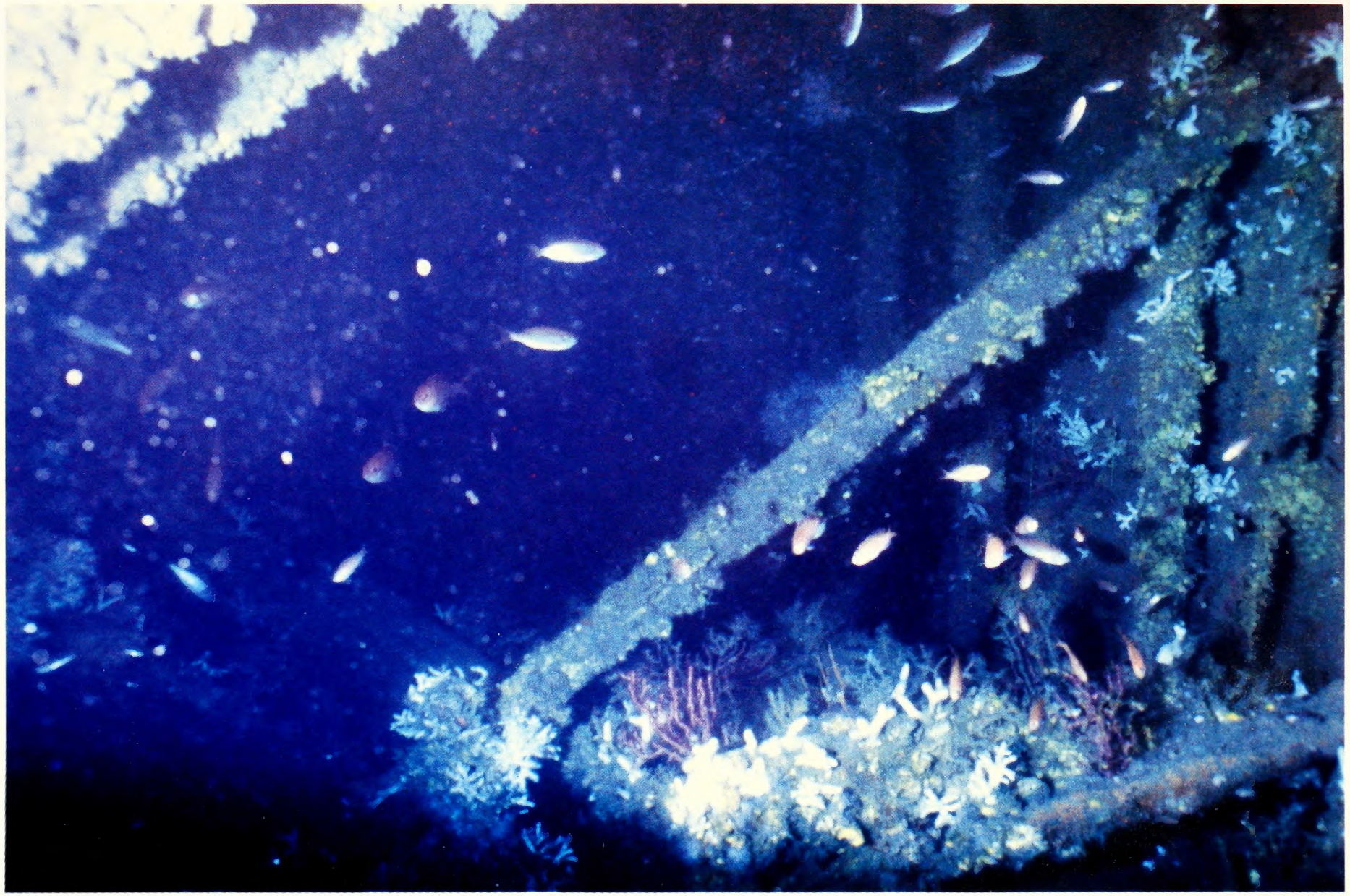


Figure 122. Coal bunker bulkheads, originally located to the left of the row of stanchions adjacent to the port boiler, have collapsed onto the deck beams. Looking aft between the port boiler and the port armor belt, the deck is covered with coal and debris from the deteriorated side of the lower hull.

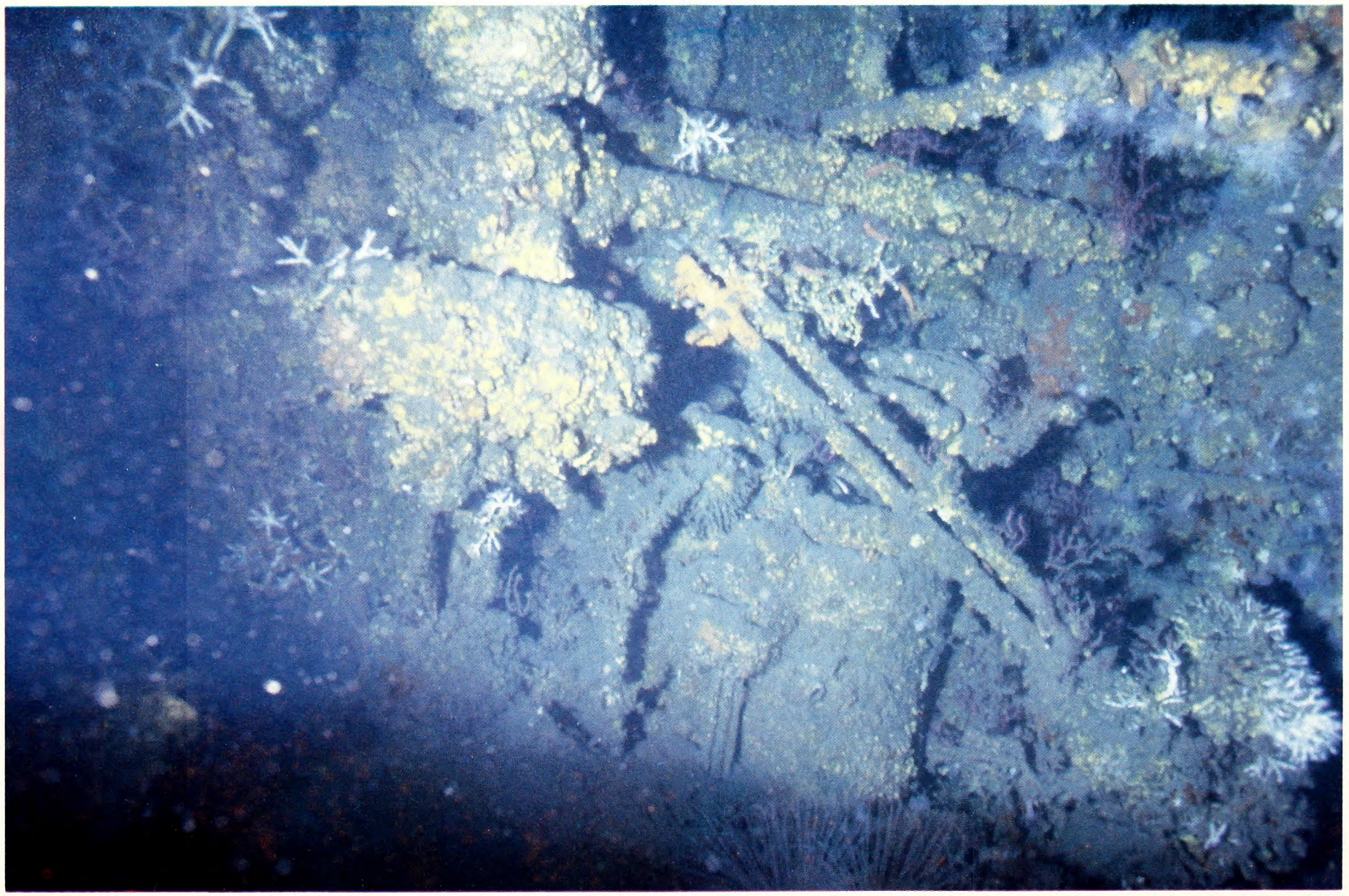


Figure 123. Although heavily coated by corrosion products and marine fouling organisms, the Monitor's steam machinery remains intact inside the lower hull. A glass tube water gauge protruding from the sediment at bottom center illustrates the excellent degree of preservation.

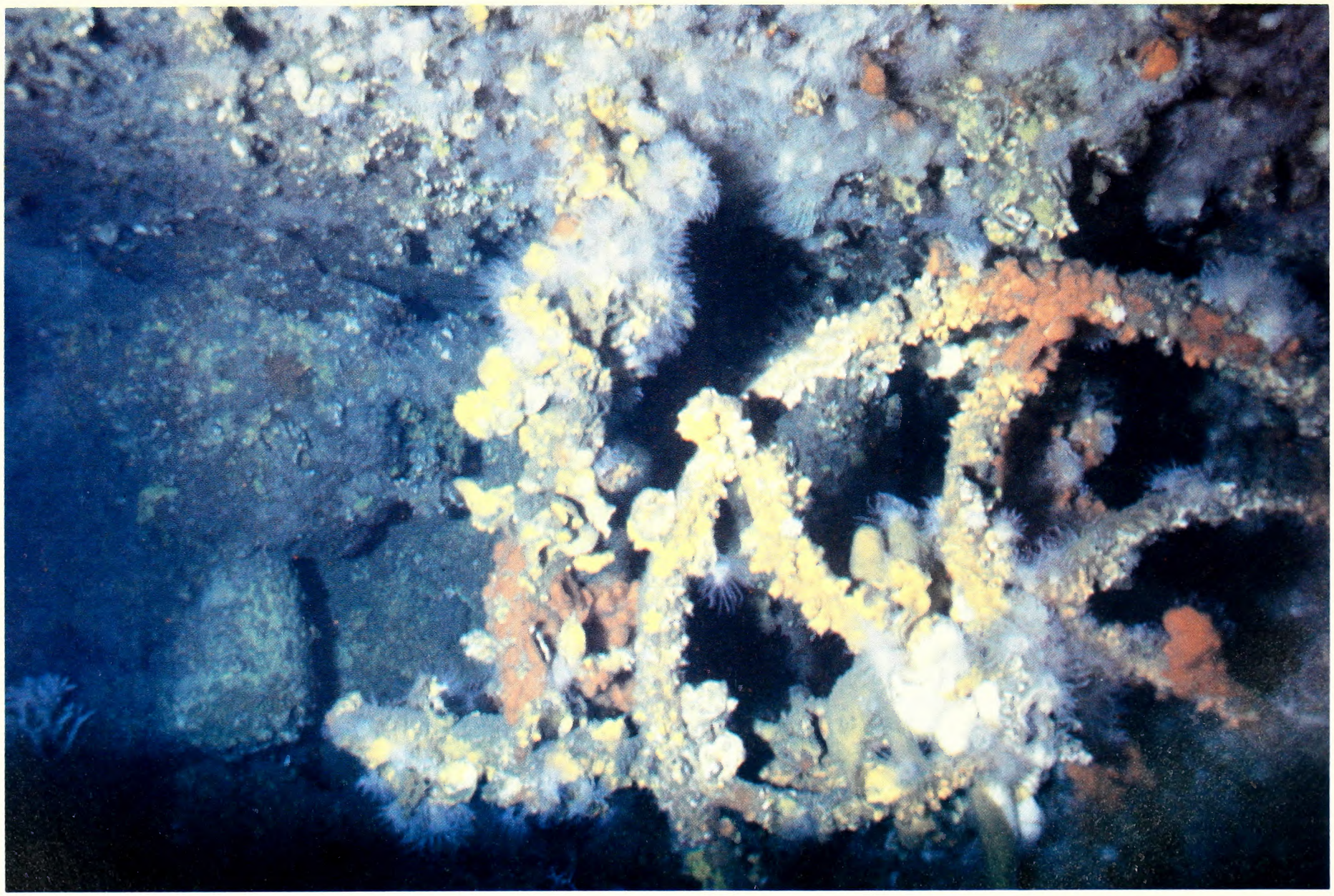


Figure 124. Amidships and forward of the engine support platform a serpentine-spoked wheel that activated a valve chest for reversing the engine remains attached to a strut protruding from the engine room bilge ceiling. To the left and aft of the wheel, the air chamber and steam cylinder for the port Worthington pump can be seen.

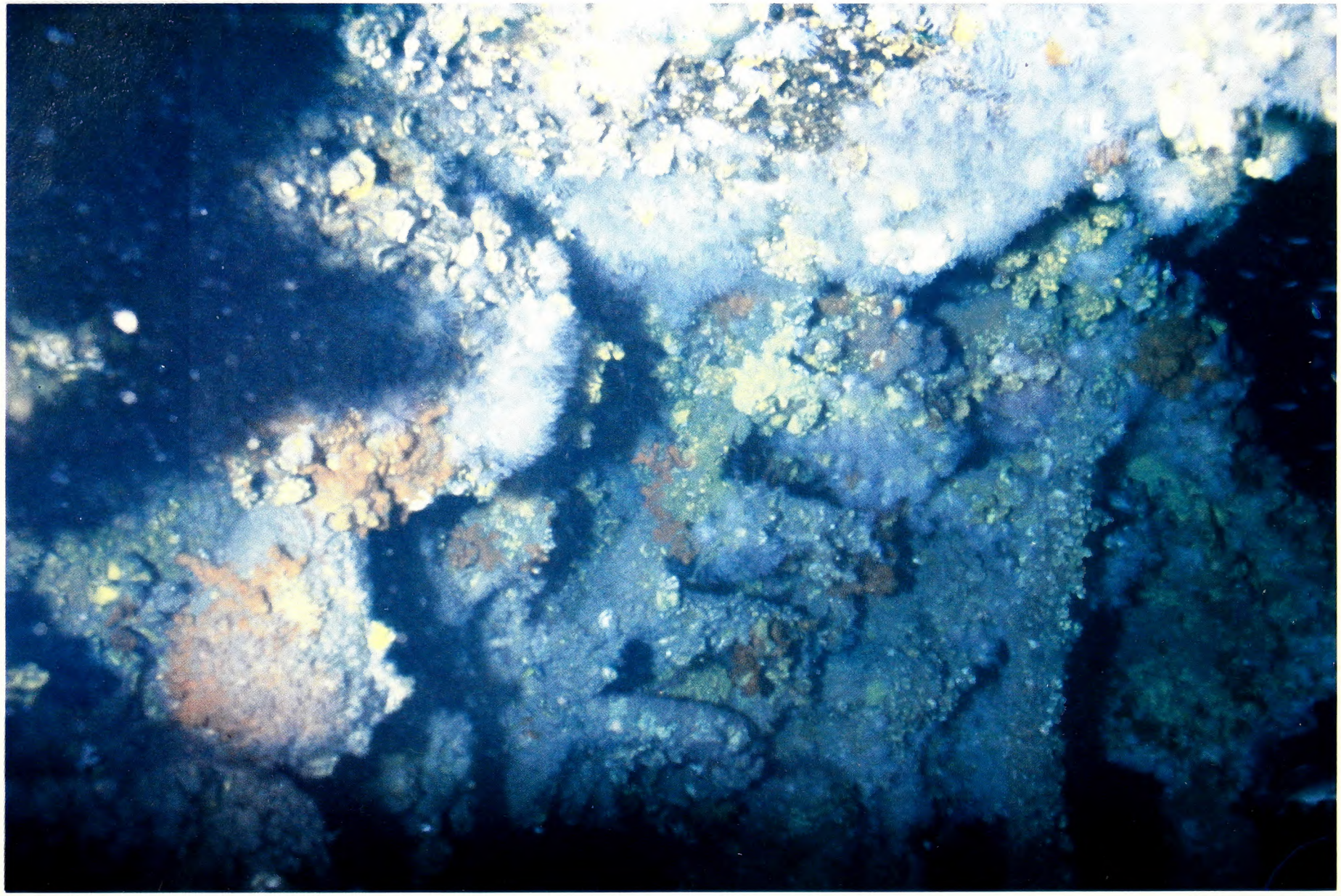


Figure 125. To starboard of the air chamber of one of two Worthington pumps located immediately forward of the steam machinery (bottom right) a stairway leads from the engineering space deck to a platform that supported the engines. Aft and to starboard of the stairway, a second blower and associated steam engine remains intact.

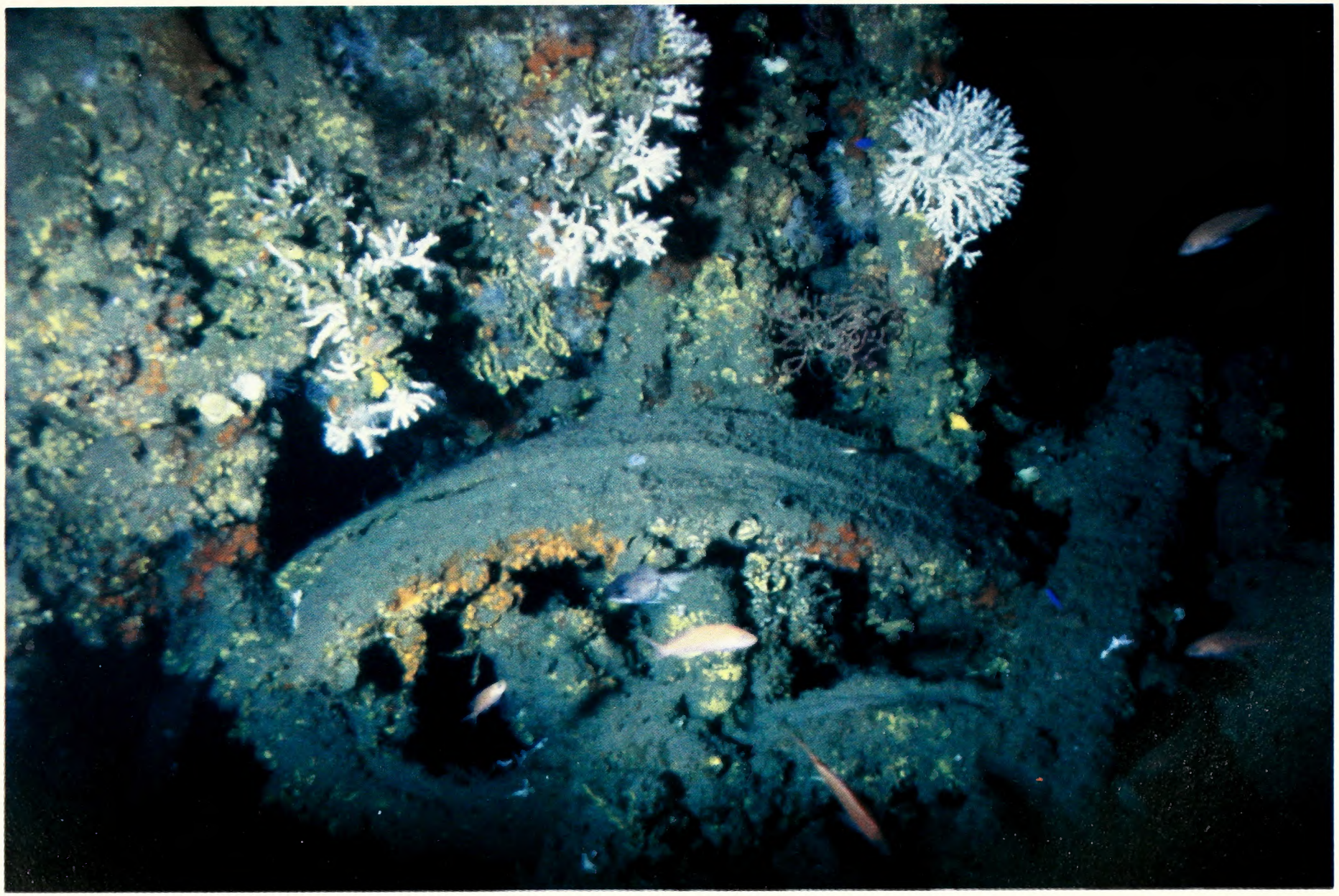


Figure 126. The heavily-concreted flywheel of the port ventilator donkey engine with leather belt intact lies just inside the armor belt in the lower hull engineering space.

Figure 127. At the stern, the starboard armor belt exhibits extensive damage and most interior wood has deteriorated.

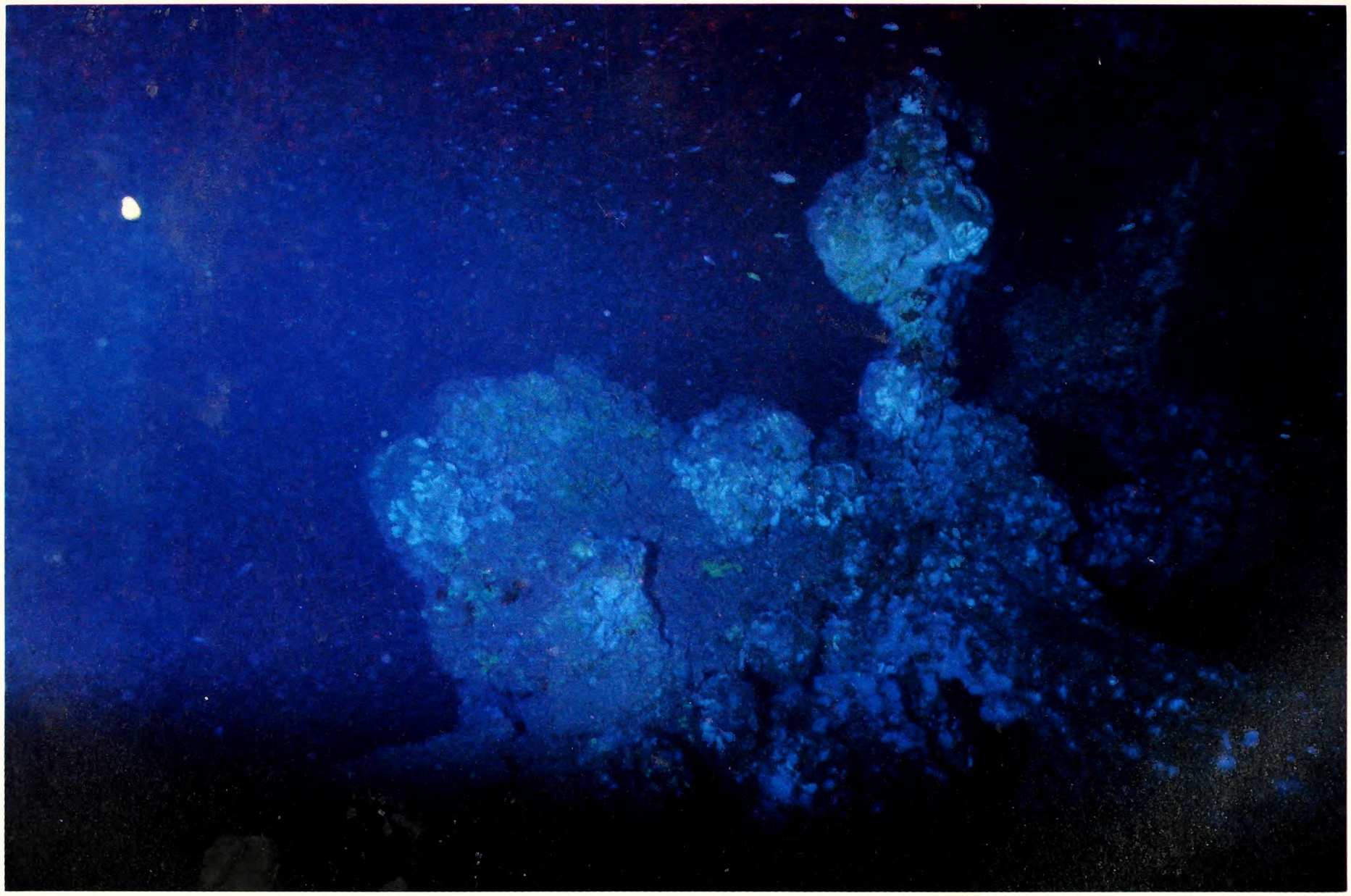


Figure 128. Photographed from the port armor belt, the four blades of Ericsson's propeller can be clearly seen. The propeller shaft extends into the photograph from the lower left corner and the yoke and propeller shaft socket appear behind the propeller and to the right. The propeller shaft no longer rests in the yoke socket and lies to the port of the yoke.

Figure 129. Beyond the turret, armor plates from the damaged after-deck of the **Monitor** *were found to have separated from their fastenings and collapsed onto the sediment. Shafts protruding from the gun ports (starboard top and port bottom) were used to secure wood gun port bucklers (covers) to heavy wrought iron pendulums inside the turret while the ship was underway.*

Examinations under the wreckage produced additional observations. Much more of the deck than originally thought was found to support itself above the bottom surface. Forward of the pilot house virtually all of the deck was observed to be free of the bottom sediment. The lower 12 inches of the pilot house structure were found to be exposed above the sediment. From this point aft to the present position of the turret the entire port side of the vessel had remained free of the bottom, supporting its own weight and that of the sediment accumulated within the confines of the hull. Aft of the engineering space the deck had suffered extensive damage and considerably less of the deck supported itself. The armor plating on the deck was found to be separating from the deck planking in several areas, indicating advanced deterioration.

At both the wardroom and amidships locations where the deck of the *Monitor* had been ruptured, material associated with the ship was found to be washing out of the wreck and onto the sediment below. The amount of material redistributed in this manner appeared to be augmented by pressure created by the current flowing over the wreck. In the vicinity of both areas this pressure was noted to create a vortex with considerable suction.

Inclinometer measurements taken along the bottom of the port armor belt and the bottom of the lower hull confirmed additional damage to the remains of the ship. Adjacent to the test excavation, longitudinal measurements recorded a 2 1/2-inch degree angle rising toward the stern. Athwartships the list to starboard was found to be virtually zero. Measurement of the list to starboard adjacent to the amidships bulkhead confirmed that it had increased to 19 degrees while the longitudinal measurement remained 2 1/2 degrees. The final measurement recorded amidships on the lower hull supported the 19-degree list to starboard and provided a slightly increased longitudinal measurement of 4 degrees. Although superficial, this information, indicated that the deck and remains of the lower hull were distorted both longitudinally and athwartships.

During the project, weather confirmed the choice of working in the sanctuary in August. Sea conditions varied from less than 1 foot to 7 feet with an average of only 3.5 feet. Wind velocity ranged from 8 to in excess of 30 miles per hour during the project. On only two occasions did the wind and sea conditions combine to prevent operations.

On the bottom currents varied from a low of 0 knots to a high of .7 knots. The prevailing directions during the project were from the southwest or northeast, although the entire 360-degree spectrum was represented on at least one occasion. Current direction and visibility appeared to be closely associated, with the best visibility, in excess of 175 feet, associated with a southwest current. The poorest visibility, zero, was associated with virtually no current and the appearance of a biological phenomenon that created excessive organic fallout in the lower water column. Average visibility during on-site operations was found to be more than 50 feet. Water temperature ranged from 18 to 26 degrees Celcius (64.4 to 78.8 degrees F) and, like visibility, was associated with the current direction.

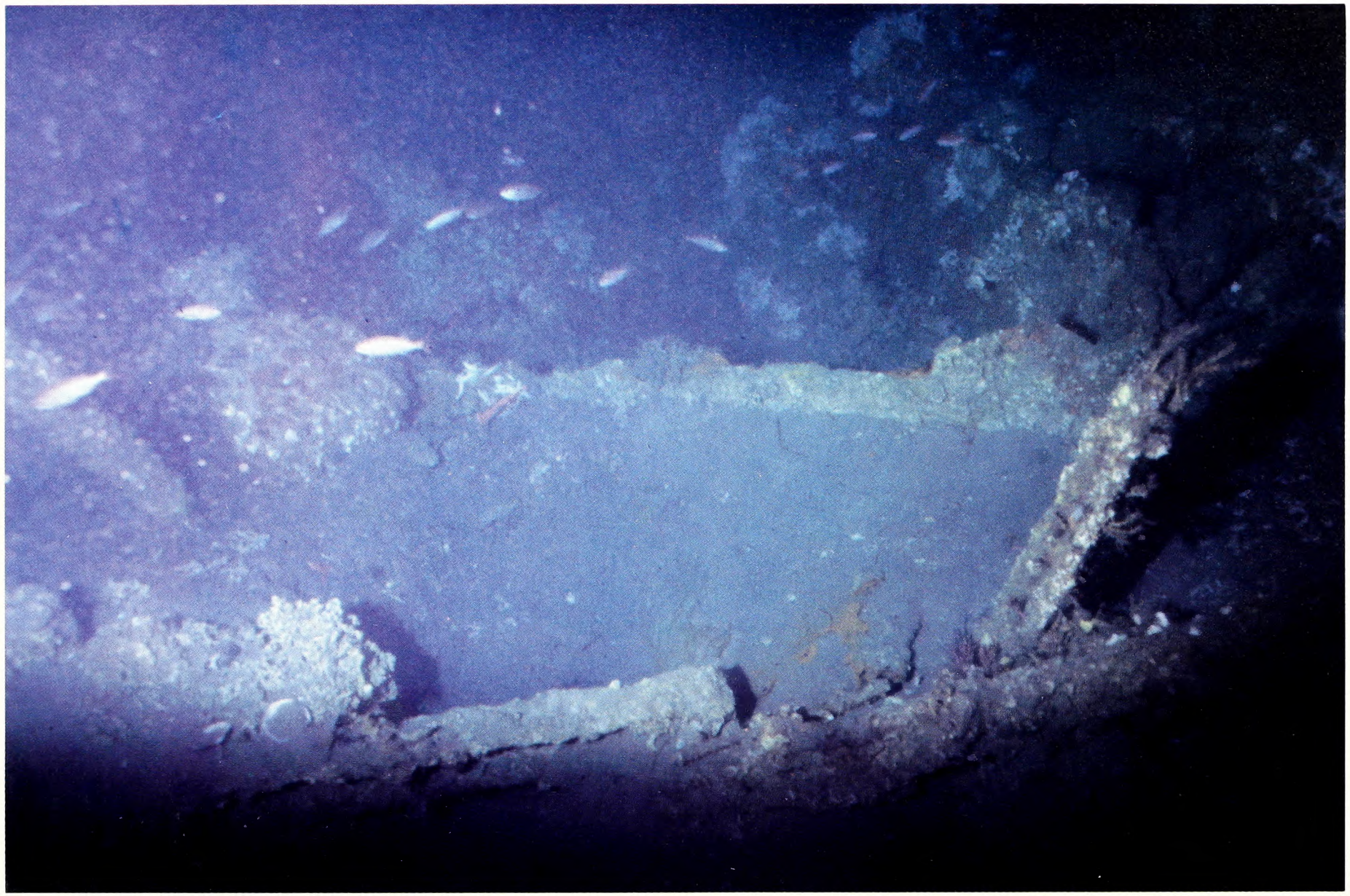


Figure 130. The location of the test excavation was inboard of the port armor belt and aft of an iron bulkhead that separated the captain's quarters from the chain locker.

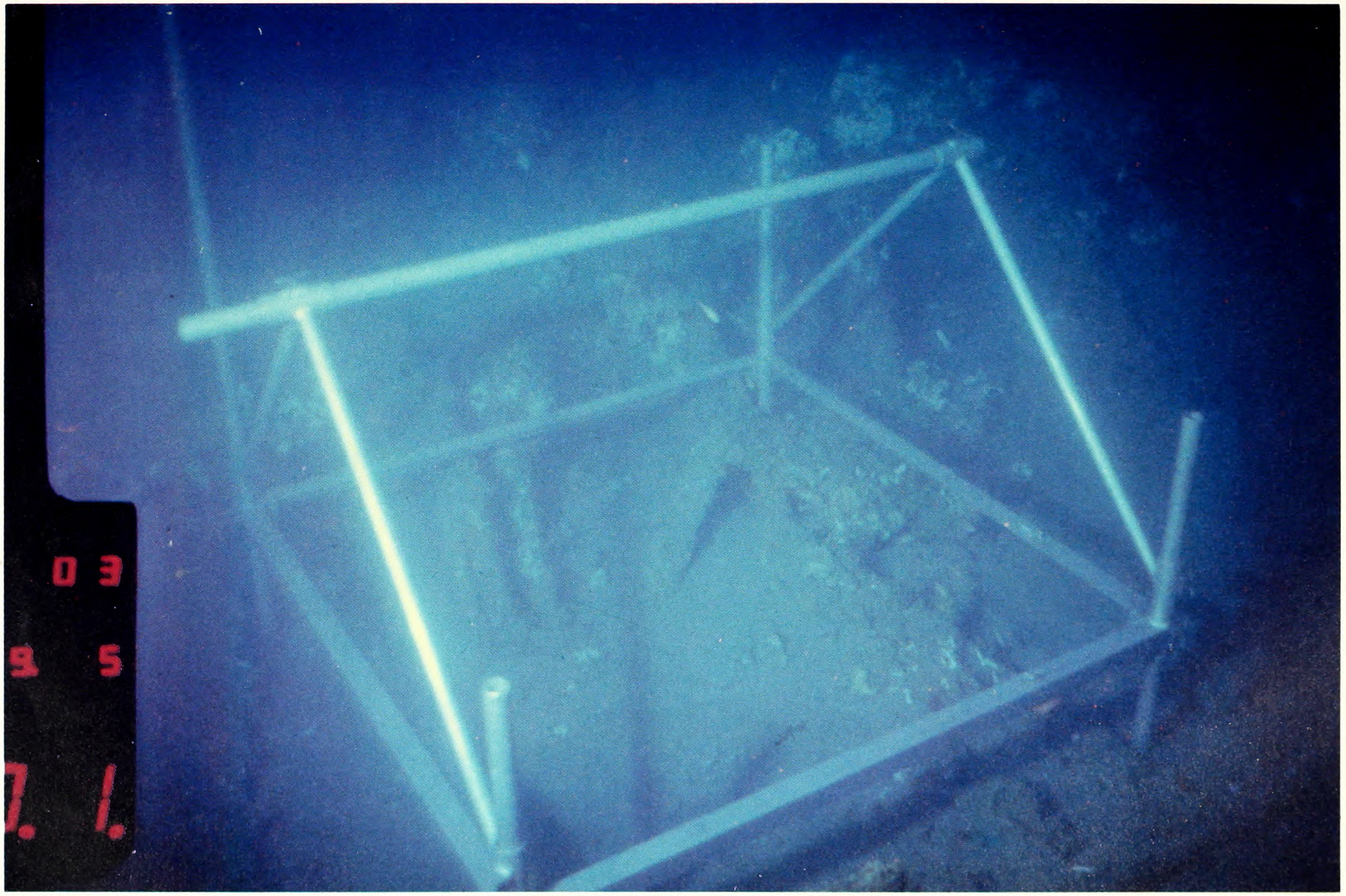


Figure 131. Erected immediately inboard of the port armor belt, an aluminum grid frame constructed by the Physics Laboratory at North Carolina State University served to control both the test excavation inside the hull and the mapping and photography required to document the investigation.

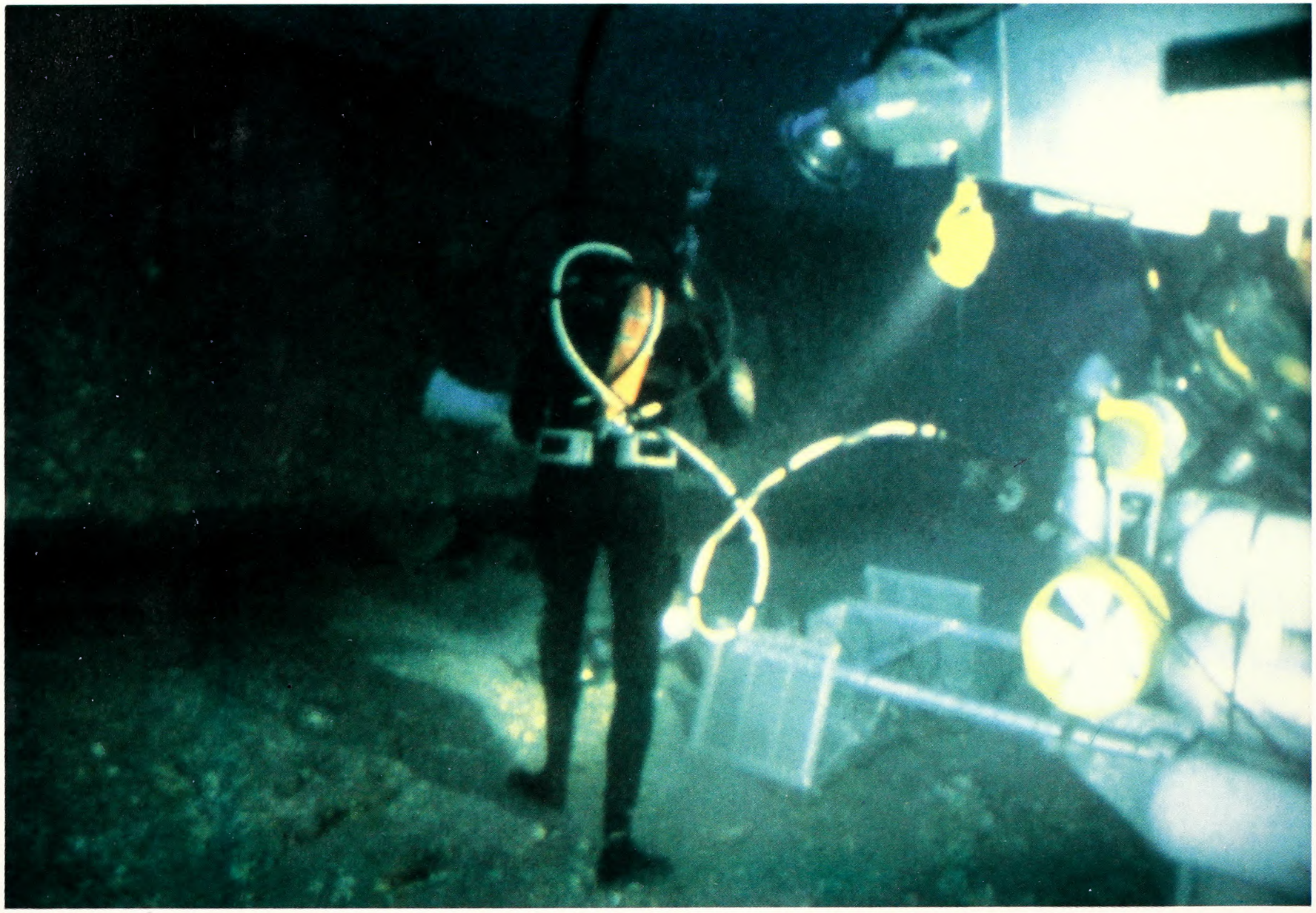


Figure 132. Standing adjacent to the port armor belt, a project archaeologist prepares to record details of the wreck and test excavation on the closed-circuit television video tape recorder carried aboard the **Johnson-Sea-Link I** *delivery system.*

Figure 133. Damage to the lower hull along the port quarter permitted access to the engineering space of the Monitor. *Debris and heavy fouling obscure all but a serpentine-spoked wheel on one of the two blowers that were used to create a forced draft for the boilers. Once-straight wrought iron stanchions (to the right of center) preserve evidence of either the dynamics of sinking or perhaps damage resulting from depth charges during World War II.*

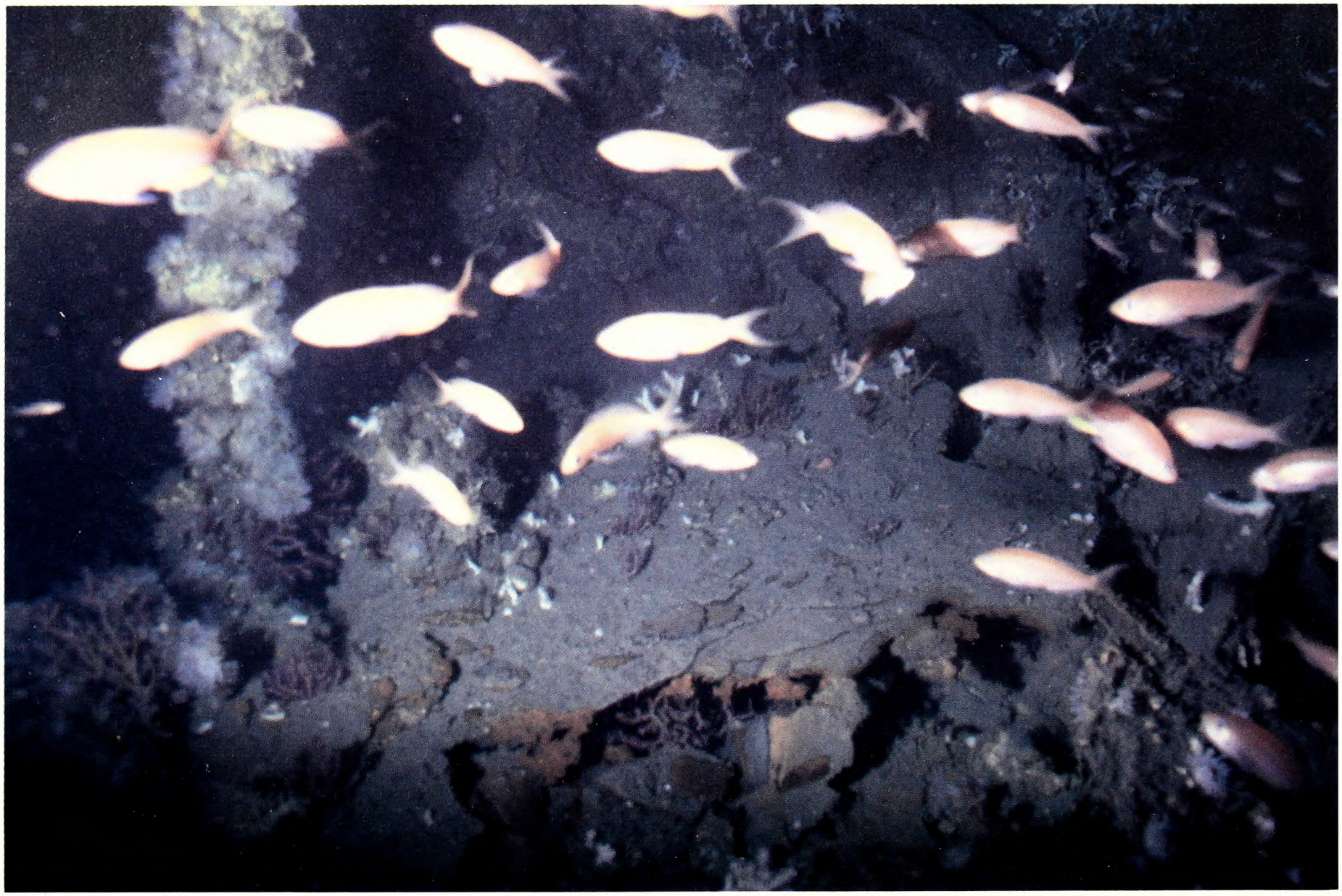


Figure 134. The fragile condition of much of the remains of the Monitor can easily be seen in the remains of an iron hull plate damaged in investigating the interior of the Monitor's engineering space aft of the amidships bulkhead.

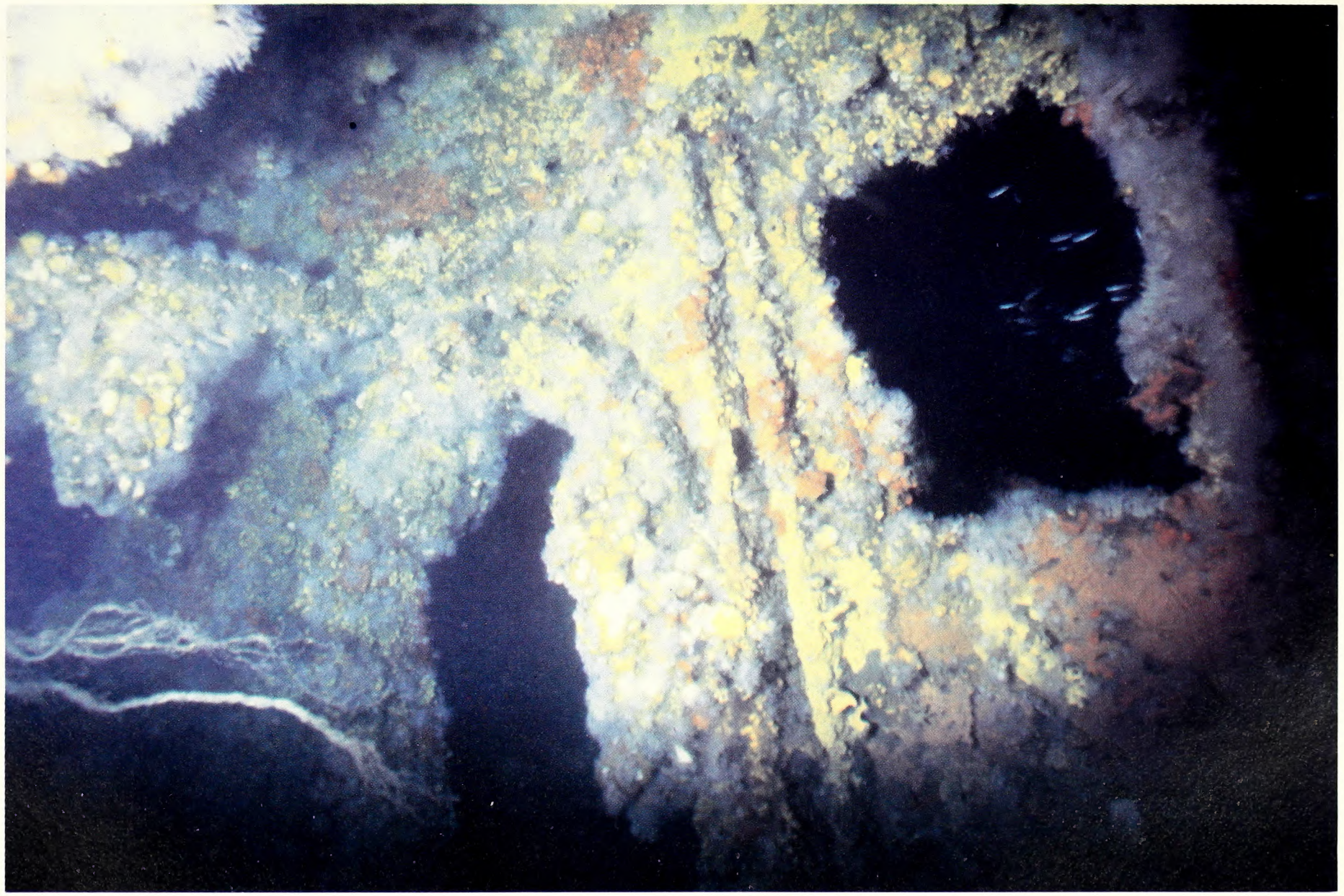


Figure 135. The starboard watertight door frame in the amidships bulkhead survives intact although plate on the bulkhead has deteriorated. To port of the turret support yoke the bulkhead has collapsed into the galley.

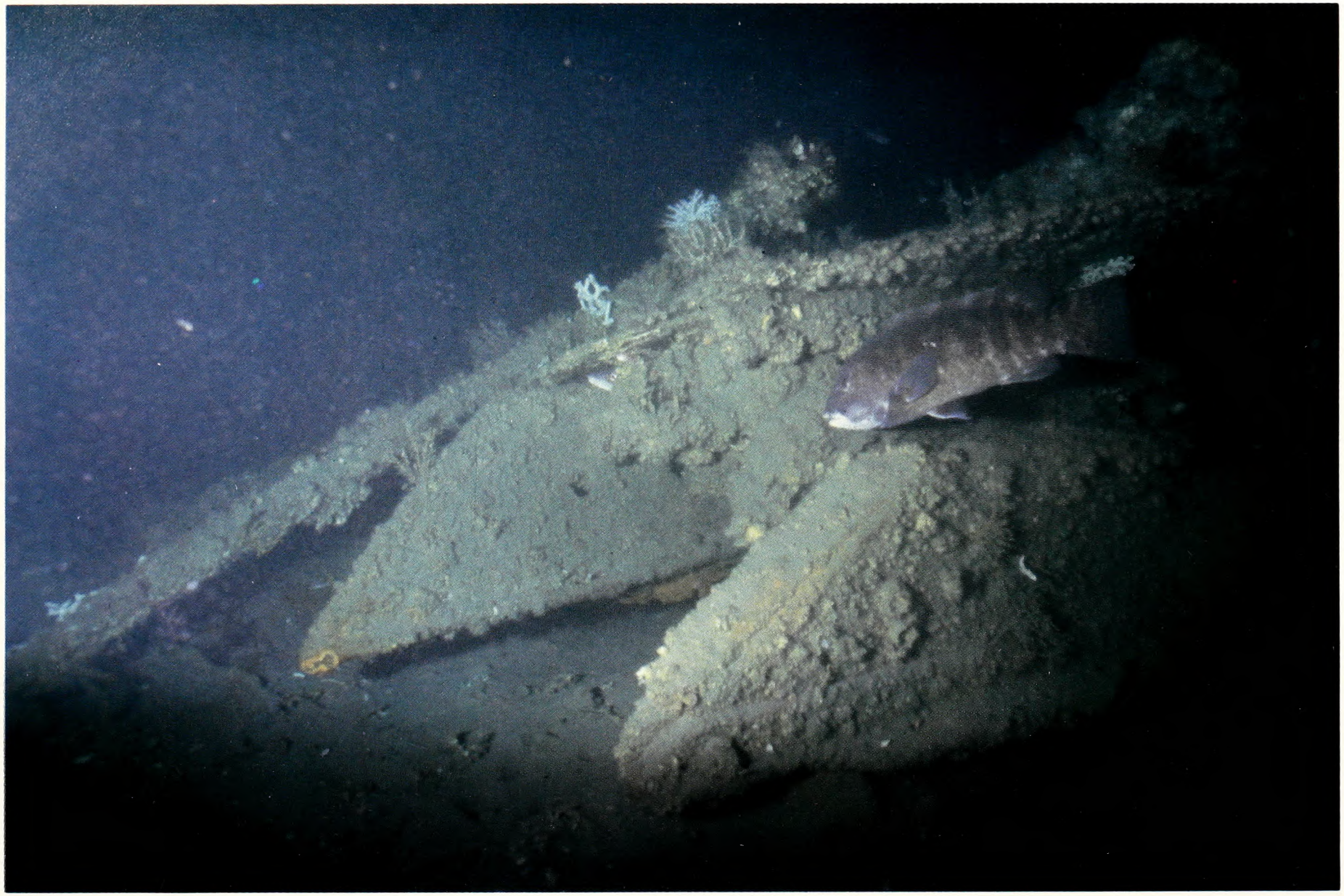


Figure 136. Iron floors and stiffners constructed of iron plate and angle preserve both the contours and construction features of the lower displacement hull of the Monitor.

Figure 137. Diagonal bracing inside the port armor belt rests on the deteriorated remains of a wood deck beam.

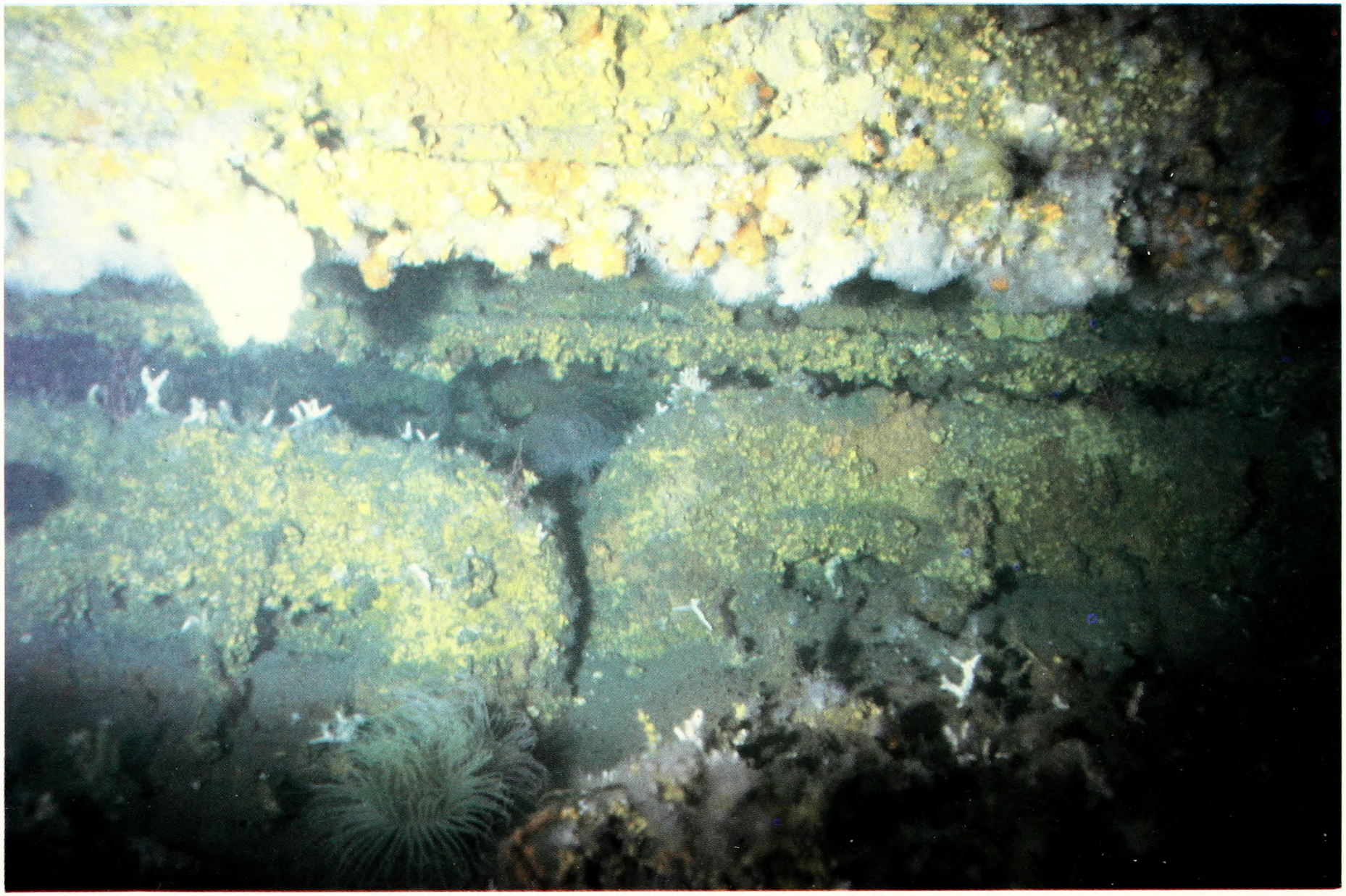


Figure 138. Large diameter pipes vent from the bottom of the boiler near their approximate center and run both inboard and outboard below the floors of the lower hull.

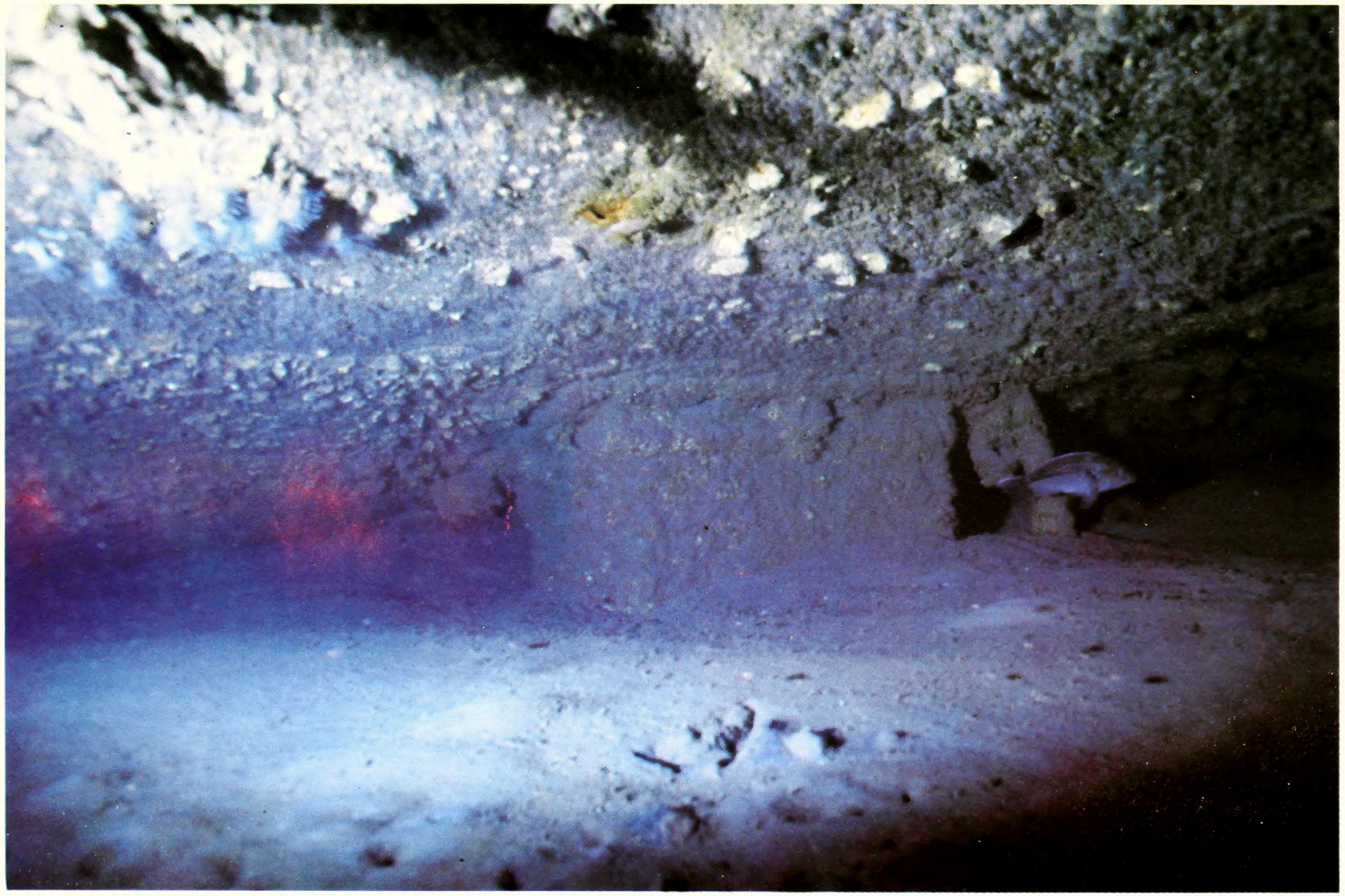


Figure 139. Forward of the turret, the port exhaust stack was exposed and intact at the base. Armor plating on the deck of the Monitor survives intact although considerable damage and deterioration were observed elsewhere.

CONCLUSIONS

Data generated by each phase of research in the *Monitor* National Marine Sanctuary supported a variety of conclusions. Whether related to the nature and scope of the archaeological record preserved at the site, condition of the vessel remains, the environment, or the complications involved in the conduct of research at the site, each of these conclusions focused additional light on the questions posed by future research and development. While data generated by the 1979 investigations did not provide sufficient information to support the formulation of definitive plans for the site, it has greatly expanded our knowledge of the *Monitor* and perhaps set the stage for the collection of data that will permit realistic and viable options to be determined.

Archaeological

Both testing and exploration of the remains of the *Monitor* confirmed that the shipwreck contains a rich and varied collection of material associated with the vessel. The broad spectrum of material represented in the limited number of artifacts recovered during the project included wood, leather, rubber-impregnated fabric, glass, ceramics, iron, brass, and provisions. Numerous fragile, yet intact, vessels of glass indicated that a considerable amount of similar material has survived both the destruction related to the sinking and subsequent natural and/or man-made deterioration at the site. The presence of a substantial accumulation of light sediment in the lower level of the test excavation indicated that excellent possibilities for the preservation of organic material exist. This potential for excellent preservation, perhaps characterized by recovered samples of relish, pepper, leather, and wood, is enhanced by the cool water temperatures recorded at the site.

While deterioration of the lower hull has contributed to the preservation of material associated with the ship, damage to the upper hull has permitted some redistribution and disturbance of original provenance. In the wardroom, magazine, and alter-engineering compartment, ruptures in the structure provided unobstructed access to the seabed below the wreck. Currents flowing across the wreck created a venturi effect at these locations and doubtlessly contributed to the distribution of material outside the confines of the hull remains. The observed presence of material from the interior of the vessel adjacent to the port armor belt in the vicinity of both the wardroom and magazine and the recovery of several bottles and a brass lantern base in the vicinity of the baseline confirmed this redistribution of material.

With the exception of these areas artifacts within the remainder of the hull can be expected to be segregated by bulkheads that divided the ship into compartments. Structural evidence exposed by the test excavation and observed in investigating the wreck indicated that both structural and nonstructural bulkheads survived the sinking to maintain the segregation of material established during the ship's operations. This segregation should provide excellent contextural information and historical association.

In addition, artifact provenance in the test excavation lends credibility to the hypothesis that the *Monitor* capsized and sank by the stern after losing reserve buoyancy. In spite of the 2 1/2-degree pitch to the bow and similar list to starboard, material in the test excavation was found to cluster adjacent to the forward face of athwartships deck beams. Had the vessel indeed rolled over and gone down by the stern, deck beams would have served as collection points for small unsecured artifacts.

In examining the sediments exposed by the test excavation, it was obvious that the upper stratum has been extremely active. The high energy of this sand and shell hash material was observed during the project and confirmed by the presence of a modern plastic garbage bag and two other pieces of modern plastic at depths of up to 14 inches. On one occasion while the R/V *Johnson* was on a three-day trip to Beaufort, North

Carolina, to take on additional fuel and diving gas, more than a foot of overburden was found to have accumulated in the test excavation. While this must be confirmed by additional test excavation in other areas inside and outside the wreck, the evidence indicated that a substantial amount of sediment could be arbitrarily moved without compromising the archaeological integrity of the site. Should the option to recover the *Monitor* be exercised, removal of this sediment could greatly reduce the dead lift weight of the vessel remains. In the test excavation this upper stratum and that which sealed the sediment containing material associated with the *Monitor* were clearly discernible.

While material inside the confines of the hull should only be removed in accordance with the strictest archaeological controls, that distributed outside the confines of the hull should require only two-dimensional provenance. This should be more than sufficient to establish an association with the wreck that has been extensively disturbed by natural or perhaps man-made processes. Material located under the wreck can be treated in a similar manner without the loss of significant data.

Engineering

Perhaps the most significant engineering data generated by on-site activities resulted from observations made during diver exploration of the wreck. Photographic records of the interior and underside of the vessel considerably enhanced our understanding of the condition of the wreck and provided heretofore unavailable insight into the condition of the *Monitor*'s remains. Several observations related directly to the questions critical to the formulation of realistic recovery plans.

All observations pertaining to the present condition of the *Monitor* confirmed that recovery plans must be based on the hypothesis that vessel remains at the site have very little overall structural integrity. With the possible exception of the turret, no part of the *Monitor* can be assumed to have retained sufficient strength to support itself under the additional stresses imposed by recovery. The construction of a litter capable of supporting the remains of the ship or an alternative that would provide complete support for the remaining structure will be essential.

Examination of exposed wood and iron confirmed the fragile condition of the wreckage. Investigation of the condition of the wood backing for the armor belt, the wood floor of the turret, and exposed deck and deck beams confirmed that teredo and pholad damage has been extensive. Wood samples recovered from the test excavation indicated that cellular deterioration has been equally extensive although, as might be expected, wood protected by sediment accumulation has retained some strength.

Examination of the iron armor and lower hull plating confirmed that the interface between plates and fastenings had deteriorated through electrochemical galvanic action. While individual plates and fastenings retained some of their original strength, the bonding surfaces have deteriorated to compromise the structure itself. While this deterioration will probably prove to be significantly less where the wreckage had been protected by the accumulation of sediment, areas of the wreck exposed to the water column have deteriorated extensively. Sagging 1-inch armor plate attached to the wood deck beams and planking confirmed this deterioration.

Inclinometer studies provided a preliminary indication of the amount of distortion in the hull remains. Ruptures in the deck in the vicinity of the wardroom magazine and after-engineering space confirmed the extent of this damage and the deterioration that has occurred. Buckling plates on the bottom of the port armor belt immediately forward of the turret suggested that this structure has also been affected by both deterioration and considerable pressure.

Examination under the vessel indicated that perhaps one-half of the wreckage was supported above the surface of the bottom. Should recovery be attempted, this space would provide important working access for the construction of a litter. While the two forward casings could not be washed into the sediment because of a consolidated layer of shell hash or material from the wreck, sediment under the wreck should prove to be no obstacle to recovery-related construction.

Conservation

While the majority of material associated with the remains of the *Monitor* presented no insurmountable conservation problems, the remains of the *Monitor* will be another matter entirely. Examination of the condition of the wreckage indicated that traditional conservation involved in the stabilization of the remains of the vessel would be staggering. Because of the composite nature of construction, the vessel would have to be disassembled, organic portions of the structure preserved one way, and the inorganic portions of the structure preserved in another. Once each part of the vessel had been cleaned and preserved, the pieces would have to be reassembled in conjunction with a structure capable of supporting the weight of surviving iron. Such a structure would also have to be capable of securing in position numerous portions of the vessel too far deteriorated to be reassembled. Compared to the complexity and expense of recovery, that of conservation, stabilization, and restoration would be extreme.

Operational

In examining the problem of conducting even limited archaeological investigations at depths requiring sophisticated breathing gasses and delivery systems, it is obvious that saturation-mode operations represent a distinct advantage. Every hour of on-site diving activity required approximately 4 1/2 hours of decompression in the chamber aboard the support ship. This schedule automatically limited daily on-site operations to a minimum of 2 hours. While the lengthy decompression schedule provided an abundance of time for evaluating and assessing each dive, the schedule became extremely taxing mentally and physically after the first two weeks. A saturation system would greatly increase the amount of on-site time and would permit a more concentrated scheduling of activities.

Working in water temperatures ranging from 18 to 26 degrees Celcius (64.4 to 78.8 degrees F) in conventional wetsuits made an endurance contest out of a number of the lockouts. With compression significantly reducing thermal properties of the wetsuits and the chilling effects of a cold breathing gas mixture added to the water temperature, archaeological priorities deteriorated rapidly toward the end of each lockout. Working slowly and meticulously in the test excavation also seemed to accelerate the effects of the cold. Toward the end of the excavation it was noted that lockout times could be extended by utilizing the last of each dive for exploration of the wreck. Exertion associated with vigorous movement appeared to generate some reserve body heat.

Communications, always a problem at depth, were additionally complicated by breathing a mixture composed of helium and oxygen. In spite of the helium unscramber, extensive communications proved impossible, eliminating the possibility of recording observations verbally. While some voices could be understood with regularity, others proved quite impossible and defied translation by the diver himself.

While the submersible delivery and support system provided adequate support for the limited objectives of a test excavation, extensive work at depth will require a different type of diving system. Additional power for tools would have to be available before extensive excavations could be carried out with efficiency. Complicated tasks could have been accomplished faster and with a higher degree of accuracy had more than one investigator been able to lock out at the same time.

RECOMMENDATIONS

Prior to the development of plans for further investigation in the *Monitor* National Marine Sanctuary, additional engineering and historical research tasks should be addressed. Both have a critical bearing on the development and assessment of options for future investigation and development of the *Monitor*. As on-site time is limited, every operation should be designed to maximize the variety and amount of data collected.

Prerequisite to the effective planning and development of engineering studies designed to address options for development of the site is a program of historical research designed to identify extant engineering data comtemporary with the construction and refitting of the *Monitor*. While much of this is underway, it should be expanded to locate and analyze any primary source material associated with the refitting of the vessel in the Washington Navy Yard in 1862. All available data should be converted into a series of engineering drawings that can be used in the formulation of plans for future investigation and the development of engineering feasibility studies for the recovery of the remains of the *Monitor*. Compilation of these drawings will isolate aspects of the vessel's design and construction that can only be identified through research at the site and define those on-site observations required to collect that information.

Before planning another extensive project at the site, a comprehensive engineering analysis of recovery feasibility should be carried out based on both historical and on-site research data. The project should be designed to analyze all extant data in light of a minimum of three options: 1) recovery of the entire vessel intact; 2) recovery of the entire vessel in sections; and 3) recovery of the turret without damaging the remains of the hull. In every case, planning must be based on the premise that remains of the *Monitor* no longer have sufficient structural integrity to support themselves under the additional stress of recovery operations. This study should also identify any additional information from the site that is required before decisions regarding recovery options can be made and should spell out methods of collecting that data. Recovery options should carry the project through the transporation of the remains of the *Monitor* to a safe harbor and address deposition of the shipwreck, its parts, or the turret in a container or containers suitable for long-term storage and stabilization.

In light of the complexities, expense, and final results of conventional conservation and stabilization of the *Monitor*, it might be worthwhile to assume that the most feasible postrecovery options for storage and display would be to maintain the wreck in its present condition in an environment similar to that of the *Monitor* National Marine Sanctuary. This would eliminate the majority of the tremendous cost of disassembly, cleaning, conservation, reassembly, and long-term curation associated with conventional conservation, yet not preclude that possibility at some future date. Appropriately maintained as it exists today, the wreck would provide an excellent exhibit, deterioration could be retarded or arrested by electrochemical methods, research on the wreck could continue to generate data about the ship and crew, and objects from the wreckage could be removed as necessary for research, preservation, and interpretive exhibits.

From an archaeological perspective the next phase of on-site operations should be designed to continue site documentation and testing. Tests excavations should be carried out outside the confines of the hull on both the north and south sides of the wreckage. On the north side the excavation should be located adjacent to the turret and immediately forward of the amidships bulkhead. On the south side of the wreck testing should be carried out immediately forward of the amidships bulkhead. Each of the test excavations proposed for areas outside the confines of the hull remains should be designed to document the distribution of material associated with the wreck in the sediment profile.

Inside the hull of the ship additional testing should be carried out inboard of the starboard armor belt immediately forward of the amidships bulkhead and in the engineering space inboard of the starboard armor belt between the boilers and blowers. A final test excavation should be conducted immediately forward of the ruptures in the deck above the magazine. Excavations outside the hull confines should be limited to 10-foot-by-10-foot squares and those inside the confines of the hull to 5-foot-by-5-foot squares unless the delivery and support systems provide more on-site diver time and mechanical assistance than were available in 1979.

Additional research at the site should also be designed to complete placement of the series of datum casings so that additional research can be readily tied to a master reference grid. Once this has been established, a series of profiles of the wreck should be made to determine accurately the degree of list, pitch, and distortion. These profiles would also serve as a frame of reference for establishing a three-dimensional plan of the wreck using photogrammetric data collected in 1977.

Future work at the site should be designed to permit an investigation into the turret. Data concerning the interior of the structure will be essential to planning and assessment of recovery options and provide answers to myriad historical, engineering, and archaeological questions. Perhaps in conjunction with this investigation a thorough and systematic closed-circuit and photographic study of the wreckage could be accomplished. Information from both of these projects would be valuable regardless of the orientation of future options and could be effectively utilized in developing educational programs and exhibits.

In light of the tremendous interest in research and development of the *Monitor* considerable emphasis should be placed on the development of displays and exhibits to convey to the public the significance of the ship, nature of research in the *Monitor* National Marine Sanctuary, and options for development of the site as a resource of national significance. Although the ship may never be raised, films and publications can be designed to compensate for the inaccessability of the site.

Before permitting any operations in the *Monitor* National Marine Sanctuary that are designed to recover material from the ship or portions of the vessel itself, a comprehensive plan, staff, and facilities for conservation should be available. If facilities and funding for the punctual cleaning, conservation, and storage of material from the site cannot be assured prior to proposed operations, no project to recover material should be permitted. Today, with the exception of laboratories in Texas, Florida, New York, and Maine, adequate facilities do not exist. Finally, an effort should be made to increase the effectiveness of surveillance in the *Monitor* National Marine Sanctuary. The Cousteau operation in May, 1979, certainly illustrates the accessability of the site for anyone with moderately sophisticated equipment. Although diving from the surface with conventional sport diving equipment represents a tremendous risk, the *Monitor* and the material that the site contains are of sufficient value to make the illegal operation attractive.

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CREDITS

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APPENDIX 1

Artifact Inventory

ARTIFACT INVENTORY

Glass, Ceramic

001 Intact wine bottle, dark green, no markings.

002 Intact bottle, light green; "MUSTARD" and "US NAVY" on opposite sides.

007 Bottle, light green; broken; "PEPPER" and "US NAVY" on opposite sides.

039 Cathedral pickle bottle, light green; top broken; no markings.

041 Base fragment of square bottle, dark brown; possibly Plantation Bitters; molded design on sides; no markings.

079 Intact bottle, light green; "MUSTARD" and "US NAVY" on opposite sides.

103 Intact bottle, light green; "MUSTARD" and "US NAVY" on opposite sides.

104 Intact bottle, light green; "MUSTARD" and "US NAVY" on opposite sides.

105 Intact bottle, light green; "MUSTARD" and "US NAVY" on opposite sides.

106 Storage jar with seal and lid, light green; no markings on jar; "PATENTED OCT. 19, 1858" on top of lid; "HARTELL'S GLASS AIR-TIGHT COVER" around sides of lid; top of lid decorated with 17 raised pointed beads of glass, one broken.

108 Base of square bottle, light green; no markings.

115 Two pieces of possibly three-piece soap dish, porcelain white; no markings. One piece has holes for straining water; second piece, which fits under the first, is solid.

116 Fragment of large plate, ironstone, white; no markings.

Wood

005 Wood fragment with brass hinge attached.

006 Rectangular wooden block.

040 Concreted wood fragment.

049 Wood fragment.

050 Wood fragment.

051 Wood fragment.

052 Wooden louver.

053 Wood fragment.

054 Wood fragment.

056 Rectangular wooden block.

057 Wood fragment.

058 Wood fragment.

059 Wood fragment.

061 Piece of tongue and groove panelling, does not join with other four pieces.

060 Four pieces of tongue and groove panelling that join together.

062

063

064

065 Wood fragment.

066 Wood fragment

067 Wood fragment.

068 Wood fragment.

069 Wood fragment.

070 Wood fragment.

071 Wood square (piece of box).

072 Wood fragment.

073 Wood fragment.

074 Wood fragment.

075 Wood fragment.

076 Wood fragment.

080 Wood fragment.

081 Wood fragment.

082 Wood fragment.

083 Wood fragment.

084 Wood fragment.

085 Wood fragment.

087 Wood fragment.

088 Wood fragment.

090 Wood fragment.

091 Wood fragment.

092 Wood fragment.

094 Wood fragment.

095 Wood fragment.

096 Wood fragment.

Metal, Non-ferrous

011 Brass ring, possibly grommet.

043 Brass lamp base; constructed of three pieces; lead balls and leather seal in bottom section; decorative motif around first section.

Metal, Ferrous

004 Four unidentified concretions.

038 Unidentified concretion.

077 Unidentified concretion.

078 Unidentified concretion.

086 Unidentified concretion.

089 Unidentified concretion.

093 Unidentified concretion.

098 Unidentified concretion.

099 Unidentified concretion.

101 Unidentified concretion.

102 Unidentified concretion.

109 Unidentified concretion.

110 Pipe.

112 Metal with rivets.

114 Stanchion.

Miscellaneous

003 Piece of decorative plastic, modern.

010 English walnut, intact; walnut fragments.

014 Leather, portion of book binding.

042 Lens from Edgerton camera. (returned to Edgerton)

048 Rubber hose.

055 Cork bung.

097 Piece of rubberized fabric.

100 Round metal cap with perforations.

117 Coal sample.

APPENDIX 2

Abstracts of Dive Logs

ABSTRACTS OF DIVE LOGS

DATE:	August 1, 1979	DIVE NUMBER:	718
OBJECTIVES:	Reconnaissance of wreck. Placed pinger on port side adjacent to armor belt and aft of amidships bulkhead. Examined proposed datum casing locations and recorded depth at each station.		
PILOT:	Tim Askew	OBSERVER:	Gordon Watts
TENDER:	Mike Mitchell	DIVER:	John Broadwater
	TOTAL LOCKOUT TIME: None		

DATE:	August 1, 1979	DIVE NUMBER:	719
OBJECTIVES:	Laid baseline. Positioned #2 datum casing. Deployed datum casing harness and washed #2 datum casing into position.		
PILOT:	Roger Cook	OBSERVER:	Dom Liberatore
TENDER:	Richard Roesch	DIVER:	Gordon Watts
	TOTAL LOCKOUT TIME: 45 minutes		

DATE:	August 2, 1979	DIVE NUMBER:	720
OBJECTIVES:	Attempted to jet remaining three casings. Dive aborted due to problems with leveling collar.		
PILOT:	Roger Cook	OBSERVER:	Richard Roesch
TENDER:	Bill Bond	DIVER:	Richard Lawrence
	TOTAL LOCKOUT TIME: 39 minutes		

DATE:	August 2, 1979	DIVE NUMBER:	721
OBJECTIVES:	Turret casing jetted in successfully. Bow casing jetted in to a depth of 3 feet before hitting layer of concreted shells.		
PILOT:	Roger Cook	OBSERVER:	Richard Roesch
TENDER:	Dom Liberatore	DIVER:	John Broadwater
	TOTAL LOCKOUT TIME: 50 minutes		

DATE:	August 3, 1979	DIVE NUMBER:	722
OBJECTIVES:	First-hand reconnaissance of wreck forward of amidships bulkhead. Confirmed location for test excavation. Deployed and erected grid frame on test site location adjacent to port armor belt.		
PILOT:	Roger Cook	OBSERVER:	Dom Liberatore
TENDER:	Richard Roesch	DIVER:	Gordon Watts
	TOTAL LOCKOUT TIME: 42 minutes		

DATE:	August 3, 1979	DIVE NUMBER:	723
OBJECTIVES:	Attempted to jet bow casing further into sediment; solid layer at 3 feet prevented further penetration. Number 3 casing was jetted in to a depth of 3 feet where a solid layer was encountered. A dark green glass bottle was recovered prior to jetting the #3 casing.		
PILOT:	Roger Cook	OBSERVER:	Dom Liberatore
TENDER:	Bill Bond	DIVER:	Richard Lawrence
	TOTAL LOCKOUT TIME: 38 minutes		

DATE:	August 4, 1979	DIVE NUMBER:	724
OBJECTIVES:	Leveled grid frame. Scheduled photography of excavation area was not accomplished due to malfunction of camera housing.		
PILOT:	Tim Askew	OBSERVER:	Richard Roesch
TENDER:	Mike Mitchell	DIVER:	John Broadwater
	TOTAL LOCKOUT TIME: 36 minutes		

DATE:	August 4, 1979	DIVE NUMBER:	725
OBJECTIVES:	Leveled grid frame. Photographed excavation area, grid frame, and casings. Photography was not completed due to malfunction of camera. Placed mounts for video camera on grid.		
PILOT:	Tim Askew	OBSERVER:	Dom Liberatore
TENDER:	Richard Roesch	DIVER:	Gordon Watts
	TOTAL LOCKOUT TIME: 23 minutes		

DATE:	August 5, 1979	DIVE NUMBER:	726
OBJECTIVES:	Deployed video camera. Photographed test excavation area. Removed surface sediment from excavation.		
PILOT:	Roger Cook	OBSERVER:	Mike Mitchell
TENDER:	Bill Bond	DIVER:	Richard Lawrence
	TOTAL LOCKOUT TIME: 49 minutes		

DATE:	August 5, 1979	DIVE NUMBER:	728
OBJECTIVES:	Video taped excavation area. Removed overburden.		
PILOT:	Roger Cook	OBSERVER:	Dom Liberatore
TENDER:	Mike Mitchell	DIVER:	John Broadwater
	TOTAL LOCKOUT TIME: 43 minutes		

DATE:	August 6, 1979	DIVE NUMBER:	729
OBJECTIVES:	Excavated upper sediment. Photographed excavation area.		
PILOT:	Tim Askew	OBSERVER:	Bill Bond
TENDER:	Richard Roesch	DIVER:	Gordon Watts
	TOTAL LOCKOUT TIME: 43 minutes		

DATE:	August 6, 1979	DIVE NUMBER:	730
OBJECTIVES:	Continued excavation. Reached layer of viscous mud below sand and shell hash.		
PILOT:	Tim Askew	OBSERVER:	Mike Mitchell
TENDER:	Bill Bond	DIVER:	Richard Lawrence
	TOTAL LOCKOUT TIME: 50 minutes		

DATE:	August 8, 1979	DIVE NUMBER:	731
OBJECTIVES:	Continued excavation. Approximately 8 inches of sediment were removed from northern half of the square. Recovered "US NAVY/MUSTARD" bottle. Recorded observations of floors and beams.		
PILOT:	Roger Cook	OBSERVER:	Bill Bond
TENDER:	Richard Roesch	DIVER:	Gordon Watts
	TOTAL LOCKOUT TIME: 56 minutes		

DATE:	August 8, 1979	DIVE NUMBER:	732
OBJECTIVES:	Continued Excavation.		
PILOT:	Roger Cook	OBSERVER:	Mike Mitchell
TENDER:	Bill Bond	DIVER:	Richard Lawrence
	TOTAL LOCKOUT TIME: 55 minutes		

DATE:	August 9, 1979	DIVE NUMBER:	733
OBJECTIVES:	Continued excavation. Video taped excavation area.		
PILOT:	Tim Askew	OBSERVER:	Richard Roesch
TENDER:	Mike Mitchell	DIVER:	John Broadwater
	TOTAL LOCKOUT TIME: 54 minutes		

DATE:	August 9, 1979	DIVE NUMBER:	734
OBJECTIVES:	Continued excavation. During excavation a plastic bag was encountered in the northwest corner/west wall at a depth of 14 inches. More plastic was encountered in the southeast corner. Video taped pad eyes, pilot house, and under side of wreck. The datum casing off the port side had been bumped over by the current.		
PILOT:	Tim Askew	OBSERVER:	Dom Liberatore
TENDER:	Richard Roesch	DIVER:	Gordon Watts
	TOTAL LOCKOUT TIME: 42 minutes		

DATE:	August 10, 1979	DIVE NUMBER:	735
OBJECTIVES:	Continued excavation. Removed large amounts of coral and shell. Video taped work area and portions of the wreck.		
PILOT:	Roger Cook	OBSERVER:	Mike Mitchell
TENDER:	Bill Bond	DIVER:	Richard Lawrence
	TOTAL LOCKOUT TIME: 47 minutes		

DATE:	August 10, 1979	DIVE NUMBER:	737
OBJECTIVES:	Photographed and video taped hull, under hull, and excavation area.		
PILOT:	Roger Cook	OBSERVER:	Richard Roesch
TENDER:	Mike Mitchell	DIVER:	Dom Liberatore
	TOTAL LOCKOUT TIME: 25 minutes		

DATE:	August 14, 1979	DIVE NUMBER:	738
OBJECTIVES:	Continued excavation, concentrated on the south side. Recorded measurements for photomosaic. Photographed excavation area. Video taped pilot house, made observations of plates in the vicinity of the pilot house.		
PILOT:	Tim Askew	OBSERVER:	Richard Berg
TENDER:	Richard Roesch	DIVER:	Gordon Watts
	TOTAL LOCKOUT TIME: 60 minutes		

DATE:	August 14, 1979	DIVE NUMBER:	740
OBJECTIVES:	Continued excavation. Encountered concretions.		
PILOT:	Tim Askew	OBSERVER:	Dom Liberatore
TENDER:	Richard Berg	DIVER:	Richard Lawrence
	TOTAL LOCKOUT TIME: 54 minutes		

DATE:	August 15, 1979	DIVE NUMBER:	741
OBJECTIVES:	Probed south side of excavation grid. Encountered third layer of sediment consisting of light viscous mud; no shell or coral.		
PILOT:	Roger Cook	OBSERVER:	Richard Roesch
TENDER:	Mike Mitchell	DIVER:	John Broadwater
	TOTAL LOCKOUT TIME: 54 minutes		

DATE:	August 15, 1979	DIVE NUMBER:	743
OBJECTIVES:	Continued excavation in south half of grid. Encountered half-round wood beam running athwartships and wood fragments. Carried out photography for mapping top of sediment.		
PILOT:	Tim Askew	OBSERVER:	Dr. Charles Aquadro
TENDER:	Richard Roesch	DIVER:	Gordon Watts
	TOTAL LOCKOUT TIME: 50 minutes		

DATE:	August 16, 1979	DIVE NUMBER:	744
OBJECTIVES:	Continued excavation of south half of grid. Uncovered the remains of wood paneling extending down from a rounded piece of wood and paralleling the east wall. Also located a large number of wood fragments.		
PILOT:	Tim Askew	OBSERVER:	Mike Mitchell
TENDER:	Bill Bond	DIVER:	Richard Lawrence
	TOTAL LOCKOUT TIME: 53 minutes		

DATE:	August 16, 1979	DIVE NUMBER:	746
OBJECTIVES:	Straightened datum casings. Recorded inclinometer measurements.		
PILOT:	Tim Askew	OBSERVER:	Richard Roesch
TENDER:	Dom Liberatore	DIVER:	Mike Mitchell
	TOTAL LOCKOUT TIME: 31 minutes		

DATE:	August 16, 1979	DIVE NUMBER:	747
OBJECTIVES:	Continued excavation of south half of grid to a depth of approximately 4 feet. Recovered pieces of wood paneling. Cleared a portion of a large timber running horizontal and athwartships. Encountered numerous wood fragments. The east quarter of the excavation grid was leveled to depth of the first quarter. Conducted a general reconnaissance of the wreck, making observations of the lower hull, frames, damaged areas, engineering space, and boilers.		
PILOT:	Roger Cook	OBSERVER:	Bill Bond
TENDER:	Richard Roesch	DIVER:	Gordon Watts
	TOTAL LOCKOUT TIME: 51 minutes		

DATE: August 17, 1979 DIVE NUMBER: 748

OBJECTIVES: Continued excavation. Horizontal timber was uncovered in the west quadrant. A piece of what appeared to be leather protruded from the south wall. Encountered wood fragments, concretions. Two of each were recovered. Recovered a small metal ring, a walnut, and walnut fragments. Conducted reconnaissance of wreck during which "US NAVY/-PEPPER" bottle was recovered from forward of the amidships bulkhead.

PILOT: Roger Cook OBSERVER: Mike Mitchell

TENDER: Bill Bond DIVER: Richard Lawrence

TOTAL LOCKOUT TIME: 55 minutes

DATE: August 18, 1979 DIVE NUMBER: 749

OBJECTIVES: Conducted video tape reconnaissance of wreck, concentrating on amidships and engineering areas. Also taped boilers, bull gear, the area under the turret, and the gun ports.

PILOT: Tim Askew OBSERVER: Bill Bond

TENDER: Dom Liberatore DIVER: Mike Mitchell

TOTAL LOCKOUT TIME: 36 minutes

DATE: August 18, 1979 DIVE NUMBER: 751

OBJECTIVES: Continued excavation. Examined and recovered an exposed 2-inch section of rubberized fabric. Examined an exposed deck beam. Exposed additional rubberized fabric and wood fragments. Recovered a round wooded disc and a two-piece soap dish. On return to submersible recovered the remains of a brown bottle. On straightening #3 datum casing recovered a pickle bottle and a concretion. Recovered a brass/leather object from in front of the submersible. Photographed engineering space, turret support, bulkhead jam, boilers, and blower.

PILOT: Tim Askew OBSERVER: Mike Mitchell

TENDER: Richard Roesch DIVER: Gordon Watts

TOTAL LOCKOUT TIME: 53 minutes

DATE: August 19, 1979 DIVE NUMBER: 752

OBJECTIVES: Dive scrubbed due to zero visibility.

PILOT: Roger Cook OBSERVER: Dom Liberatore

TENDER: Bill Bond DIVER: Richard Lawrence

TOTAL LOCKOUT TIME: 0

DATE: August 22, 1979 DIVE NUMBER: 754

OBJECTIVES: Cleaned sediment from excavation. Conducted video reconnaissance of turret. No access was located. Observed what appeared to be boiler smoke stacks under hull. Recovered two concretions, two wood fragments, an aluminum mount from 1977 operations. Observed that datum casings #3 and #4 had been pushed over by current.

PILOT: Roger Cook OBSERVER: Dom Liberatore

TENDER: Bill Bond DIVER: Richard Lawrence

TOTAL LOCKOUT TIME: 51 minutes

DATE: August 22, 1979 DIVE NUMBER: 756

OBJECTIVES: Continued excavation. Conducted video and 35 mm. reconnaissance of turret gun port, hull damage inboard of turret, engine room, boilers, coal bunkers, galley, pumps, bulkhead remains. Recovered coal sample from the area of coal bunkers.

PILOT: Roger Cook OBSERVER: Richard Berg

TENDER: Richard Roesch DIVER: Gordon Watts

TOTAL LOCKOUT TIME: 46 minutes

DATE: August 23, 1979 DIVE NUMBER: 757

OBJECTIVES: Completed excavation of southwest quadrant. Recovered what appeared to be a portion of rubber fabric and wood fragments. Conducted video and 35 mm. reconnaissance of turret, engine room, propeller.

PILOT: Tim Askew OBSERVER: Bill Bond

TENDER: Mike Mitchell DIVER: John Broadwater

TOTAL LOCKOUT TIME: 44 minutes

DATE: August 23, 1979 DIVE NUMBER: 759

OBJECTIVES: Continued excavation of southwest quadrant. Conducted reconnaissance of turret to locate hatch. Probed turret floor.

PILOT: Tim Askew OBSERVER: Richard Roesch

TENDER: Bill Bond DIVER: Richard Lawrence

TOTAL LOCKOUT TIME: 47 minutes

DATE: August 24, 1979 DIVE NUMBER: 761

OBJECTIVES: Recorded measurements for mapping of excavation area. Recovered large section of pipe, davit. Recovered "US NAVY/MUSTARD" bottle from armor belt area. Recovered Mason-type jar with original contents from wardroom area. Examined wardroom area and deck light.

PILOT: Roger Cook OBSERVER: Richard Roesch
TENDER: Richard Berg DIVER: Gordon Watts

TOTAL LOCKOUT TIME: 60 minutes

DATE: August 24, 1979 DIVE NUMBER: 763

OBJECTIVES: Continued excavation of southeast quadrant. Reconnaissance of wardroom area to examine decklight. Recovered ironstone ceramic fragment.

PILOT: Roger Cook OBSERVER: Dom Liberatore
TENDER: Mike Mitchell DIVER: John Broadwater

TOTAL LOCKOUT TIME: 31 minutes

DATE: August 25, 1979 DIVE NUMBER: 764

OBJECTIVES: Continue excavation. Attempted to recover remaining foul weather gear. Conducted reconnaissance of wardroom area.

PILOT: Tim Askew OBSERVER: Mike Mitchell
TENDER: Bill Bond DIVER: Richard Lawrence

TOTAL LOCKOUT TIME: 44 minutes

DATE: August 26, 1979 DIVE NUMBER: 766

OBJECTIVES: Recovered artifact basket and grid via lift bags. Recovered broken square light green bottle from west wall of wardroom. Photographed wardroom.

PILOT: Roger Cook OBSERVER: Richard Roesch
TENDER: Mike Mitchell DIVER: John Broadwater

TOTAL LOCKOUT TIME: 44 minutes

DATE: August 26, 1979 DIVE NUMBER: 767

OBJECTIVES: Recovered three "US NAVY/MUSTARD" bottles from north side of damaged area forward of amidships bulkhead. Probed turret to locate gun truck rails. Photographed stern.

PILOT: Roger Cook OBSERVER: Richard Berg
TENDER: Bill Bond DIVER: Richard Lawrence

TOTAL LOCKOUT TIME: 44 minutes

APPENDIX 3

Relish Sample Analysis

National Food Processors Association
1133 Twentieth Street N.W., Washington, D.C. 20036
Telephone 202/331-5900

Washington Research Laboratory
Chemistry Division
Edgar R. Elkins, Jr.
Director
202/331-5975

October 10, 1980

Ms. Dina Hill
Underwater Archeological Research Branch
Division of Archives and History
North Carolina Department of Cultural Resources
P.O. Box 58
Kure Beach, North Carolina 28449

Dear Ms. Hill:

I am sending the results of our nutritional analyses of the Monitor relish, and a list of ingredients that we feel are present.

I have attempted to determine if lead was used in the production of this type of glass. Susan Myers of the Smithsonian feels that lead was not used, but during this era, cullet was used in glass production, and that this broken glass could have been of any composition. Another possibility is contamination in the production of the relish if an earthenware vessel with a lead glaze had been used.

Thank you for your help and I will return your slides after my November 6th presentation.

Yours truly,

Janet A. Dudek

Janet A. Dudek
Manager, Nutrition Projects

JAD:jt

tsc

Technical Service Corporation 1133 Twentieth Street, N.W., Washington, D. C. 20036

Telephone:

NUTRITION DATA FORM

Company: _____ Date Reported: _____

Sample: Monitor Relish Code: _____

Size: _____ TSC # _____

Proximate

*Calories (100g) 22.44

Solids (%) 7.02

Protein (%) 1.04

Carbohydrate (%) 3.13

Fat (%) 0.64

Ash (%) 2.21

Fiber (%) _____

Minerals

Calcium (mg/100g) 36.8

Iron (mg/100g) 2.24

Sodium (mg/100g) 681

Potassium (mg/100g) 255

Lead (PPM) 16.9

Vitamins

Carotene (IU/100g) 565

Thiamine (mg/100g) 0.002

Riboflavin (mg/100g) 0.074

Niacin (mg/100g) 0.50

Vitamin C (mg/100g) 0.61

Fatty Acids % Saturated _____

% Unsaturated _____

Monitor Relish

pH 3.2

Cloves
Onions
Pepper Seeds
Cucumbers
Mustard Seeds
Pepper Corns
Mushrooms

**Calories Calculation*
Protein (4) — Fat (9) — Carbohydrates (4)

APPENDIX 4

Coal Sample Analysis

Department of Energy
Pittsburgh Energy Technology Center
P.O. Box 10940
Pittsburgh, Pennsylvania 15236

March 23, 1981

Dina B. Hill
Underwater Archaeology Branch
Division of Archives & History
P. O. Box 58
Kure Beach, NC 28449

Dear Ms. Hill:

Enclosed is the report L06746 of the test results on the coal from the USS Monitor.

Coals are classified by rank, i.e., according to their degree of metamorphism or progressive alteration in the natural series from lignite to anthracite, in accordance with the Standard Specifications for Classification of Coals by Rank of the ASTM. The basic scheme of classification is according to fixed carbon and calorific value calculated to the mineral-matter-free basis. But Section 6, ASTM Method D-388-77 states that unless properly sampled the coal should not be used for classification purposes. The conclusion that suggests itself at this time (and we emphasize the word suggests) is that the parameters which the coal exhibits point to the anthracite type of coal. We hope to apply a number of more sophisticated techniques in the near future to further characterize the coal.

Sincerely,

John E. Puskas

John E. Puskas, Acting Chief
Coal Analysis Branch

Enclosure:
As stated

Department of Energy

COAL-ANALYSIS REPORT

LAB NO. L06746

ORGANIZATION: COAL ANALYSIS
SAMPLE ID: CANAL-FROM WRECK OF USS MONITOR
CAN NO: -

OPR: NC DEPT OF CULTURAL RESOURCES MINE: ATLANTIC OCEAN
STATE: - COUNTY: - BED: -
TOWN: -

DATE OF SAMPLING: AUG-79 DATE RECEIVED: 2-26-81 DATE OF REPORT: 3-12-81
COLLECTOR: DINA B. HILL

	COAL [AS RECD.]	COAL [MOIST FREE]	COAL [MOIST,ASH FREE]
PROXIMATE ANALYSIS			
MOISTURE	3.11	N/A	N/A
VOLATILE MATTER	5.36	5.53	5.87
FIXED CARBON	85.91	88.67	94.13
ASH	5.62	5.80	N/A
ULTIMATE ANALYSIS			
HYDROGEN	2.55	2.27	2.41
CARBON	85.12	87.86	93.27
NITROGEN	.85	.87	.93
SULFUR	1.09	1.12	1.19
OXYGEN [IND]	4.78	2.08	2.21
ASH	5.62	5.80	N/A
HEATING VALUE[BTU/LB]	13571	14007	14870

ASH - INITIAL DEFORMATION 2360 F
SOFTENING TEMP 2450 F
FLUID TEMP 2620 F

FREE SWELLING INDEX 0.0